

The
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OCTOBER-DECEMBER, 1938.

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Boobook Owl.

THE AUSTRALIAN MUSEUM

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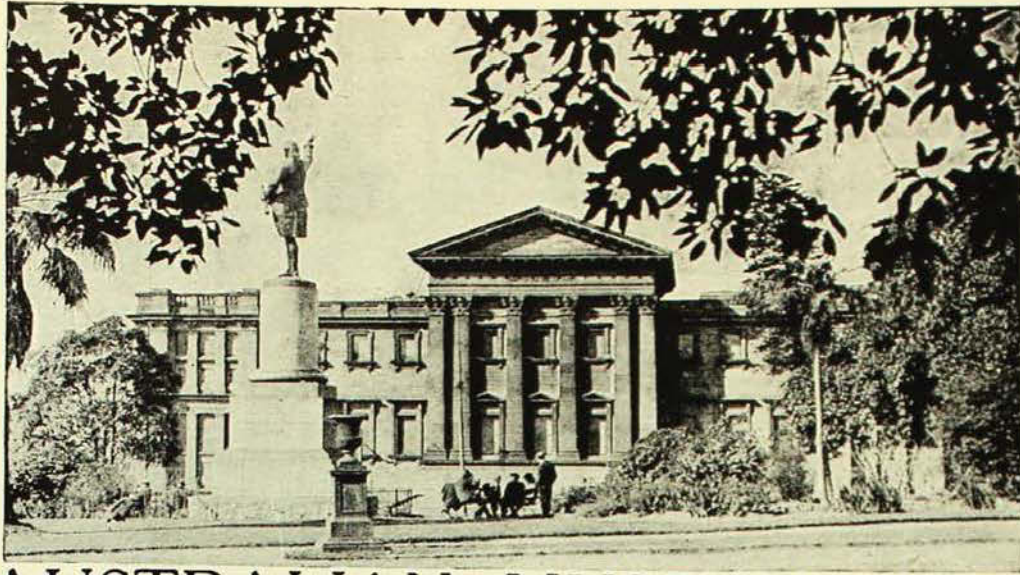
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(*Photography, unless otherwise stated, is by G. C. Clutton.*)

● OUR FRONT COVER. The Boobook Owl (*Spiloglaux boobook* Latham) is by Lilian Medland. It is one of a series of post cards issued by the Australian Museum.

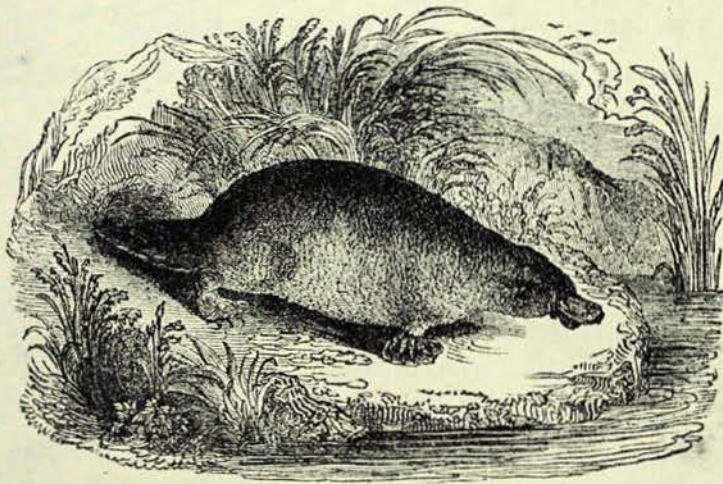
This little Owl utters the familiar "more pork" note which has been attributed wrongly to the Frogmouth, hence the trivial name of the latter. In New Zealand, however, there being no frogmouth to cause confusion, the name was rightly given to the Owl. The call sounds like *book book*, both syllables uttered very distinctly and the latter several tones lower, and so nearly resembles that of the European Cuckoo that the early settlers referred to the Cuckoo which sings by night as another example of topsy-turveydom.

The Boobook Owl is found all over Australia, and betrays its presence by the characteristic call breaking the stillness of the night. It feeds entirely at night, chiefly upon insects, though small mammals and birds are also taken. By day it hides in hollow branches, where also it places its two or three pure white eggs.

This is one of the smaller owls, but Australia also possesses in the Powerful Owl one of the largest species. This last is, curiously enough, a day feeder.

Owls are characterized by their faces, both eyes being directed forwards, and not placed on the sides of the head as in other birds.

A CATALOGUE
OF THE
SPECIMENS
OF
NATURAL HISTORY
AND
MISCELLANEOUS CURIOSITIES,
DEPOSITED IN
THE AUSTRALIAN MUSEUM.



Duck-billed Platypus, or Water-mole of Australia.

Sydney:
PRINTED BY JAMES TEGG AND CO.
ATLAS OFFICE, GEORGE STREET.
1837.



Published by the Australian Museum

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OCTOBER-DECEMBER, 1938.

Science News A Century Ago

UNDER this heading, *Nature*, 5 November, 1938, published the following item:

The Australian Museum.

"It would not be easy to imagine", said the *Mechanics' Magazine* of November 10, 1838, "a more gratifying evidence of a young colony's progress in civilization than that which is given by a handsome volume, a few copies of which have lately reached this country. The book is 'A Catalogue of the Specimens of Natural History and Miscellaneous Curiosities deposited in the Australian Museum'. It is very handsomely printed 'by James Tegg and Co., at the Atlas Office, George-street, Sydney', an offshoot from the well-known 'Thomas Tegg, at the Old Mansion House, Cheapside, London'."

"The handsome volume" was the Australian Museum's first publication, consisted of seventy-one pages, and listed less than a thousand specimens, and, as the above states, is an example of good typography. It is of interest to note the source of these beginnings of our collections. The explorers Mitchell and Sturt, and Alexander M'Leay, Colonial Secretary, figure prominently as donors. Charles Coxen and C. M. Lewis (the latter commanded the *Isabella* in an

expedition to Torres Strait in search of survivors of the *Charles Eaton*, 1836) were also prominent as donors of material.

The *Catalogue* was the work of George Bennett, who was Honorary Secretary of the Museum Committee from 1836-1838, when he became a member of that committee, and later an elective trustee till the year 1874. Bennett was the author of *Wanderings in New South Wales, Batavia, Pedir Coast, Singapore and China, being the Journal of a Naturalist in those countries during 1832, 1833 and 1834* (London, 1834) and *Gatherings of a Naturalist in Australasia . . .* (London, 1860), and many other contributions to natural science.

This *Catalogue* chronicles the fact that John Roach was collector and preserver of specimens. John Roach was a prisoner who arrived by the *Aurora* and was employed from 16 January, 1834, "in preserving Birds and other Curiosities at the rate of 1/9 a Day in lieu of Rations and Clothing". That he was engaged in field work is supported by a letter dated 6 September, 1834, signed by E. Deas

Thomson, Clerk of the Legislative Council, wherein it was authorized that he "be supplied with rations during his absence at Moreton Bay". Doubtless the specimens listed in the *Catalogue* from Moreton Bay, and not ascribed to any

donor, were the outcome of his activities.

At this period, 1836-1840, it is interesting to note that the Museum, along with the Australian Subscription Library, was housed in the former home of the Chief Justice in Bridge Street.

THE PASSING OF THE ABORIGINES: A Lifetime spent among the Natives of Australia. By Daisy Bates, C.B.E. With a Foreword by the Hon. Sir George Murray, K.C.M.G., and an Introduction by Arthur Mee. John Murray, London, 1938. 12s.

Anthropologists and the public have heard from time to time of the noble work carried out by Daisy Bates, who has spent her lifetime befriending the detribalized aborigines of Western Australia; she helped them at a time when they had lost their lands and with them their sacred life-giving dream-time centres, and when their social organization was disrupted by the white men who did not want to understand it. Though filled with anger at the annihilation of their culture, laws, and daily life, by the impact of our civilization, these aborigines were at the same time bewildered and helpless to stay the degeneration, so they died out.

For one hundred and fifty years the aborigines have wilted before the vices and diseases accompanying our civilization, and the sincere and costly efforts during this period by the various Australian Governments and missions have failed to establish a sound policy for their welfare. Mrs. Bates's account of the appalling rate of deaths among the natives at the New Norcia mission and at the isolation hospital on Dorré and Bernier Islands, Shark Bay, are illustrative in this respect. At present, however, the systematic studies of anthropologists, the expert advice of

experienced administrators of natives in New Guinea, and the lessons learnt from what has happened to the aborigines in various parts of the continent, are being heeded, and it is sincerely hoped that the policy now being evolved will meet with more success than those of the past. As Daisy Bates emphasizes, major problems to be overcome include the prostitution of native women, the provision of an efficient medical service, and a logical blending of native and European law. The moral of her book is that they are best left alone to live their own life, but economic exploitation of the country makes this an impossible ideal except in a few areas: the aborigines must be given a higher status in the community to combat adverse public opinion that is, perhaps, their greatest enemy.

Mrs. Bates tells her story in a manner delightful to read; she is a born naturalist and lover of the bush and its inhabitants. Her harrowing descriptions of the sufferings of the aborigines are relieved with interesting anecdotes of travel adventures and natural history, and a splendid series of aboriginal myths and legends. In addition the book contains much that is new to anthropologists, for she was always seeking and recording information about all aspects of aboriginal culture. It is a remarkable memento of one who has given her life to a just cause; it should be read by all, and its lessons put to practical use, for it is not yet too late to remedy our mistakes of the past.

F.D.McC.

The Aboriginal Rock Engravings of the Sydney District

By FREDERICK D. McCARTHY

EVER since Governor Phillip first drew attention to the local rock engravings in a dispatch to Lord Sydney, dated May 15, 1788, Sydney Cove, a great deal of interest, and much controversy, have been aroused regarding them. They are to be found in the area between the coast and the Blue Mountains, extending from National Park in the south to Wollombi in the north, and comprise hundreds of groups of punctured and incised rock drawings of considerable artistic merit. They are engraved on the flat and undulating expanses of rock surface common to the Hawkesbury sandstone formation, often in places which possess a commanding view of the surrounding district; thus a large number of groups is situated on prominent headlands along the numerous waterways which penetrate this rugged country, and others are on the slopes of ridges and sugarloaf hills. Many groups, however, are to be seen in secluded spots amidst thick bush or along creek and river banks.

The method employed in making these outline engravings is generally considered to have been as follows: the outline of the subject was either scratched or drawn upon the rock surface, then a series of punctures, from half an inch to one inch apart, was made with a hardened stick or pointed stone along the outline, and finally the intervening rock surface between the punctures was ground away so as to form a continuous groove. The processes are clearly indicated by the engravings themselves, for many of them are merely punctured outlines; in others, the groove is only partly made, and in others, again, the grooved outline is complete. Only one stone implement is known which can be said definitely to have been used in making the carvings; this implement was employed in the final process of grinding the grooves and was found lying on a rock besides an unfinished carving.¹

The subjects depicted are practically all naturalistic, there being exception-

¹ It is now on exhibit in the Australian Museum.

A typical setting of a group of engravings on the banks of the Hawkesbury River. The figures are delineated on the extensive rock-surface in the foreground.



ally few figures of the geometric type so common in far western New South Wales and in South and Central Australia. Man himself is seen in many moods and poses, as a hunter holding a club or spear, as a fisherman, as a dancer, and in ceremonial postures. In almost all cases the arms are upheld. A most interesting figure is a two-headed man. The mammals include whales, seals, kangaroos and wallabies, koalas, wombats, opossums, echidna or spiny ant-eaters, and flying phalangers. Birds are surprisingly few, indicating that they were not so important a food as mammals and fish; but emus are common, and penguins, ducks, shags, brush turkeys, and lyre-birds are known. The fish, which are probably in the majority, include hammer-headed and other sharks, sunfish, devil ray and sting-rays, bream, snapper, eels, and many others. Goannas are common, and snakes, tortoises, and turtles occur.

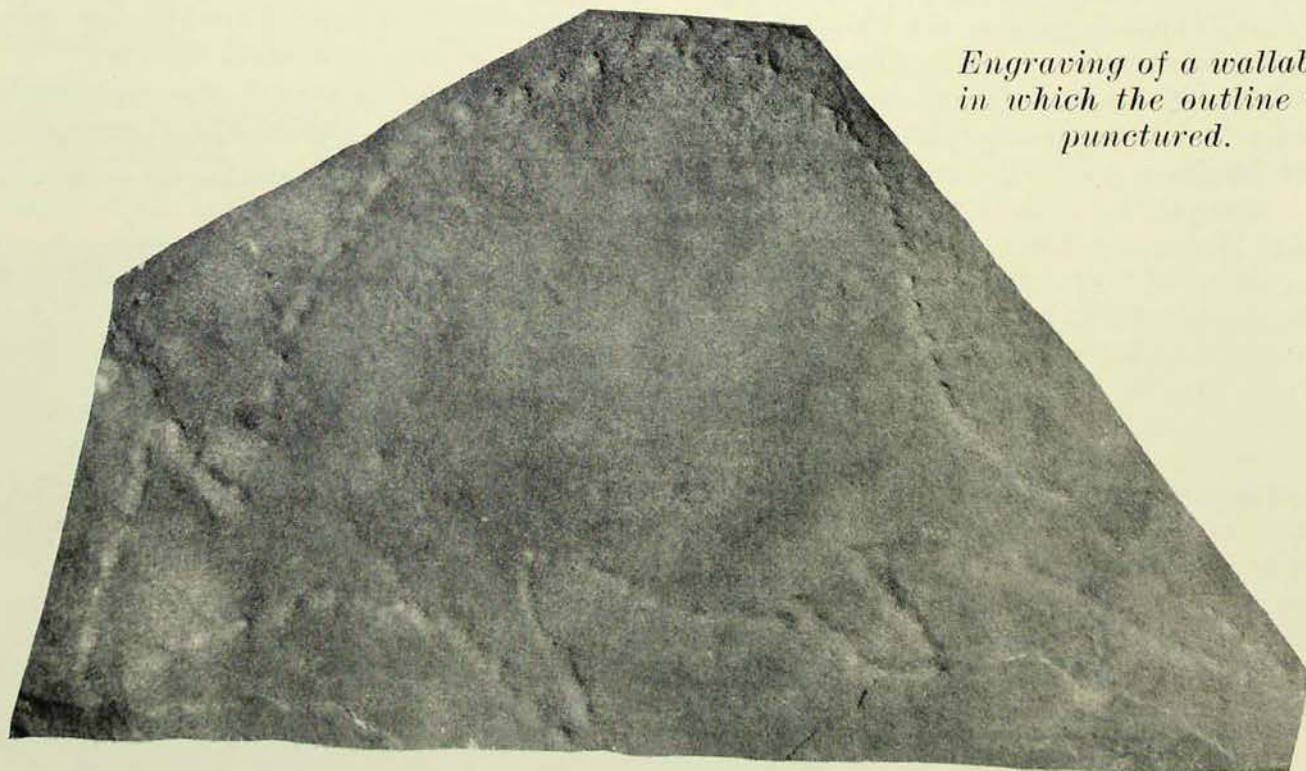
Engravings of weapons include bulbous-headed clubs, plain single-pointed one-piece spears, four-pronged fishing spears, spear-throwers, shields, returning and non-returning boomerangs. Other articles shown comprise belts, loin-

girdles and fringes, a twined ornament running from the neck to the opposite shoulder-pit, necklets (of twine and shells), head-plumes, baskets (twined), hafted stone axes, and ceremonial objects. As no specimens of the majority of these objects are to be found in museum collections in Australia, the engravings form an invaluable record of the material culture of the local tribes.

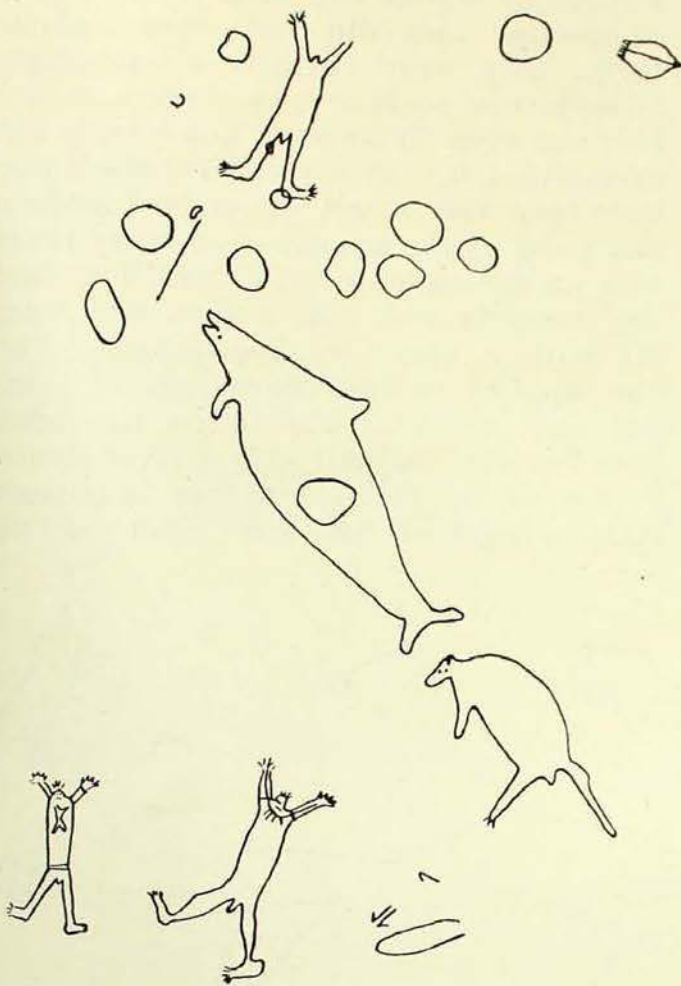
Circles occur scattered amongst other figures in a group; they may be in a row, and men are shown holding circular objects. The concentric circle motif is known, but is very rare.

A number of the figures which cannot be interpreted are probably of ceremonial significance; others are indecipherable on account of the curious angle from which the aborigine portrays his subjects.

Most interesting of all the groups, however, are those of a ritual character, which depict culture heroes and their tracks through the horde's territory. The culture heroes are always larger figures than ordinary human beings. They comprise male and female figures, often associated in pairs. Some are decorated



*Engraving of a wallaby
in which the outline is
punctured.*

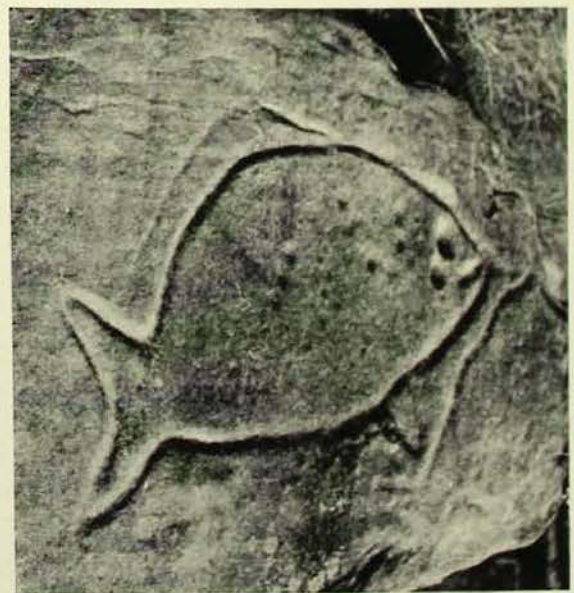


with longitudinal and transverse incisions, others are wearing head-dresses, loin, neck and shoulder ornaments, or they may be holding in their hands a fish, shield, boomerang, or hafted stone axe. The predominant type is a large male figure shown from the side so that only one leg and one arm are seen, and it occurs in many parts of the area in which the engravings are found. Among Australian tribes throughout the continent culture heroes form an important feature of religion and mythology, and they are believed to possess supernatural powers and superhuman abilities. Distinct historical rites are enacted which tell the story of their lives and their contributions to the culture of the aborigines, for they are credited with creating the social institutions and laws, the initiation rites, various customs, weapons and implements, and with punishing evil-doers. Their tracks may be seen in the groups of engravings as

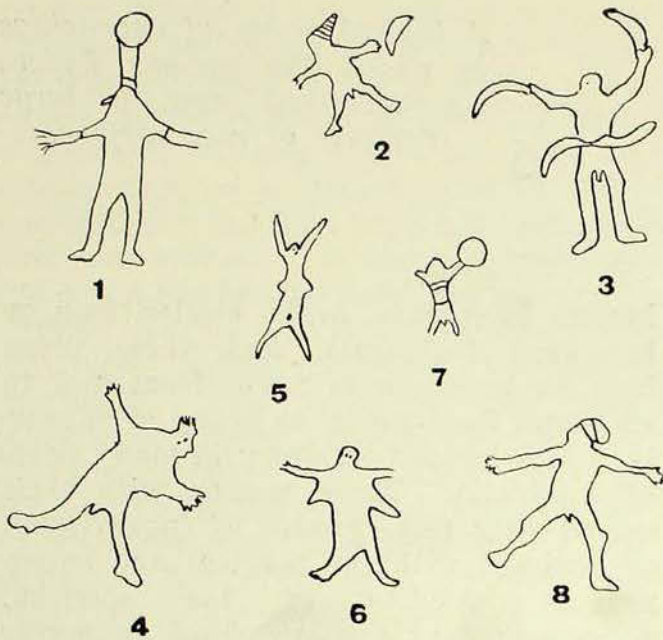
A typical group of engravings in which the various figures are scattered over a large expanse of rock-surface.

human footprints, ovals, circles, emu or kangaroo footprints, and these often lead for hundreds of yards from rock to rock and from group to group of engravings in a horde's territory in many parts of Australia. These tracks, with their sacred rites (*e.g.*, groups of engravings), are imbued with the magical and supernatural sanctity of the spiritual ancestors; they are enshrined in myths and legends, and are the scene of the most important and secret initiation, totemic and historical rites of the tribes. Such places are taboo to the women and uninitiated, for the fully initiated men only were taught the rituals.

Finally, there are figures which are combined fish and man, bird and man, mammal and man, which represent the beginning of the race, for in the myths and legends in other parts of Australia is the belief that from these creatures the culture heroes created man and the animals which form his food supply.



Engraving of a bream, in which the outline is deeply grooved.

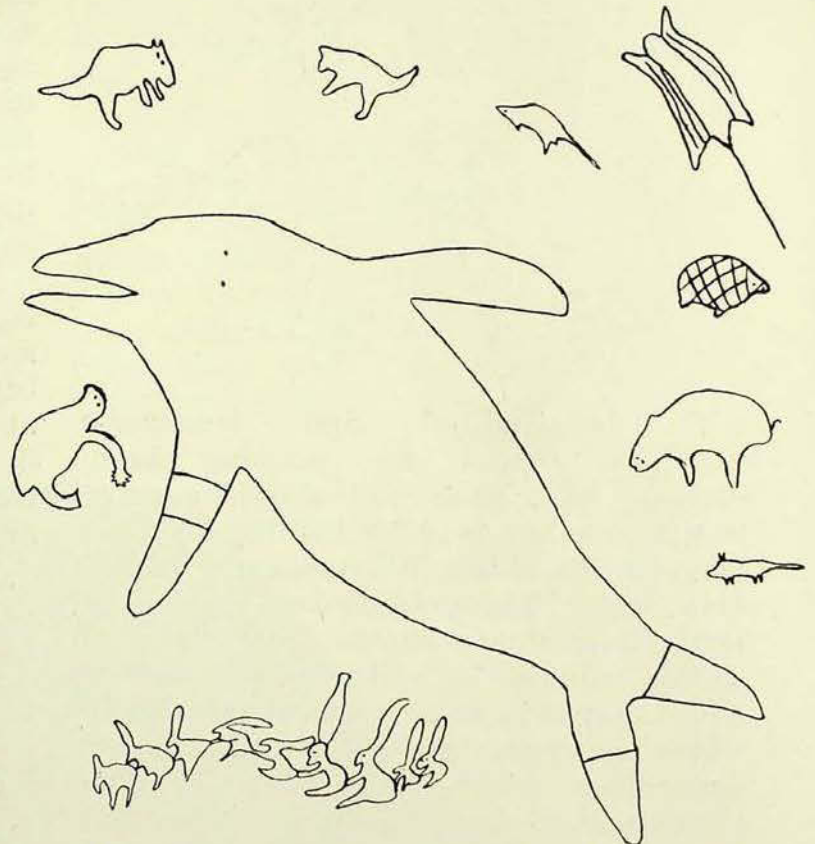


The human figure is stylized to a uniform pattern, in which the neck is absent or ill-defined, the elbows and knees are usually sharp projections, and the toes often not shown. No. 1 is wearing a ceremonial head-dress, and two styles of wearing the hair are shown in Nos. 2 and 8. No. 7 is holding a circular object, and No. 3 appears to be participating in a boomerang duel. Women's breasts always project laterally, as in Nos. 5 and 6. No. 1 is wearing armlets, and No. 7 a loin girdle.

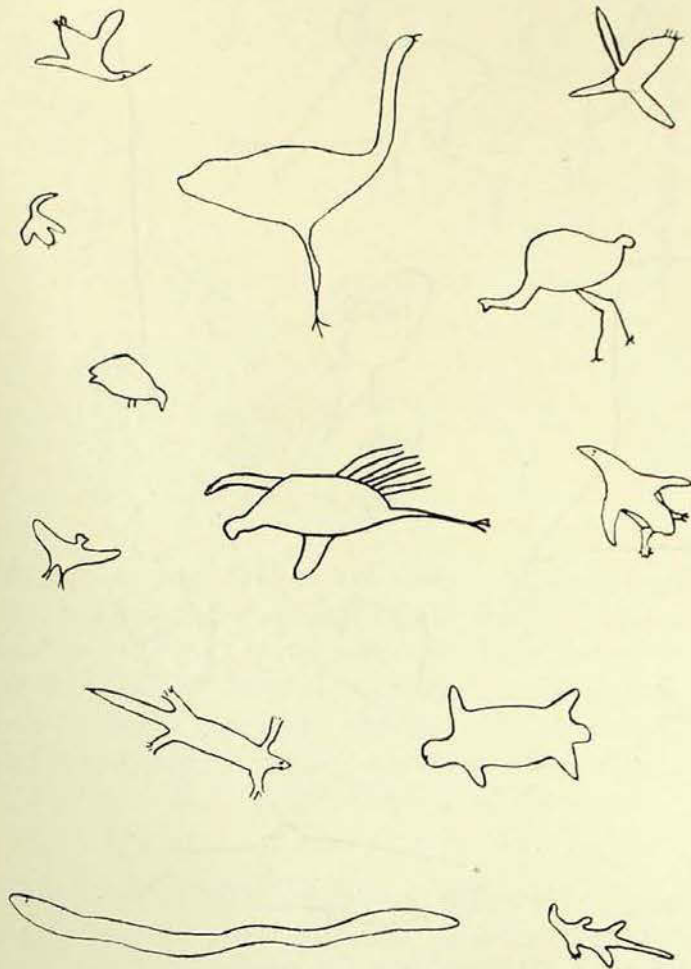
The size of the individual figures varies a great deal. Many are life size, others are enlarged out of all proportion to their natural size, and some are reduced in size. The whales and culture heroes are the largest, the former ranging up to sixty feet in length.

The artistic merit of the various animals shown in this comprehensive range of subjects is considerable. The

aboriginal artists engraved their subjects in outline and did not show contour form; they were careless about details of structure, such as toes, fingers, mouth, ears and eyes. Their skill, however, is well exemplified by the manner in which they have been able to get the correct attitude and poise of the kangaroo in many poses, such as sitting in an alert position, feeding, hopping along in a line, and being hit with a spear or boomerang. This also applies to the engravings of many fish and whales. The artist has often done his work so well that a vivid mental picture of the living creature is immediately suggested in the mind of the



Mammals. Engravings of the whale (centre), and (from top left to right) two dingoes, kangaroo-rat, flying phalanger, echidna or spiny ant-eater, wombat, and an unidentified creature. On the middle left a koala, and lower left a series of rabbit-like creatures. Rabbits were introduced in 1788 and were plentiful in the Sydney district by 1820.



Birds and Reptiles. Engravings of the shag, emu, penguin, lyre-bird, and other birds, and of the goanna, snake, and turtle.

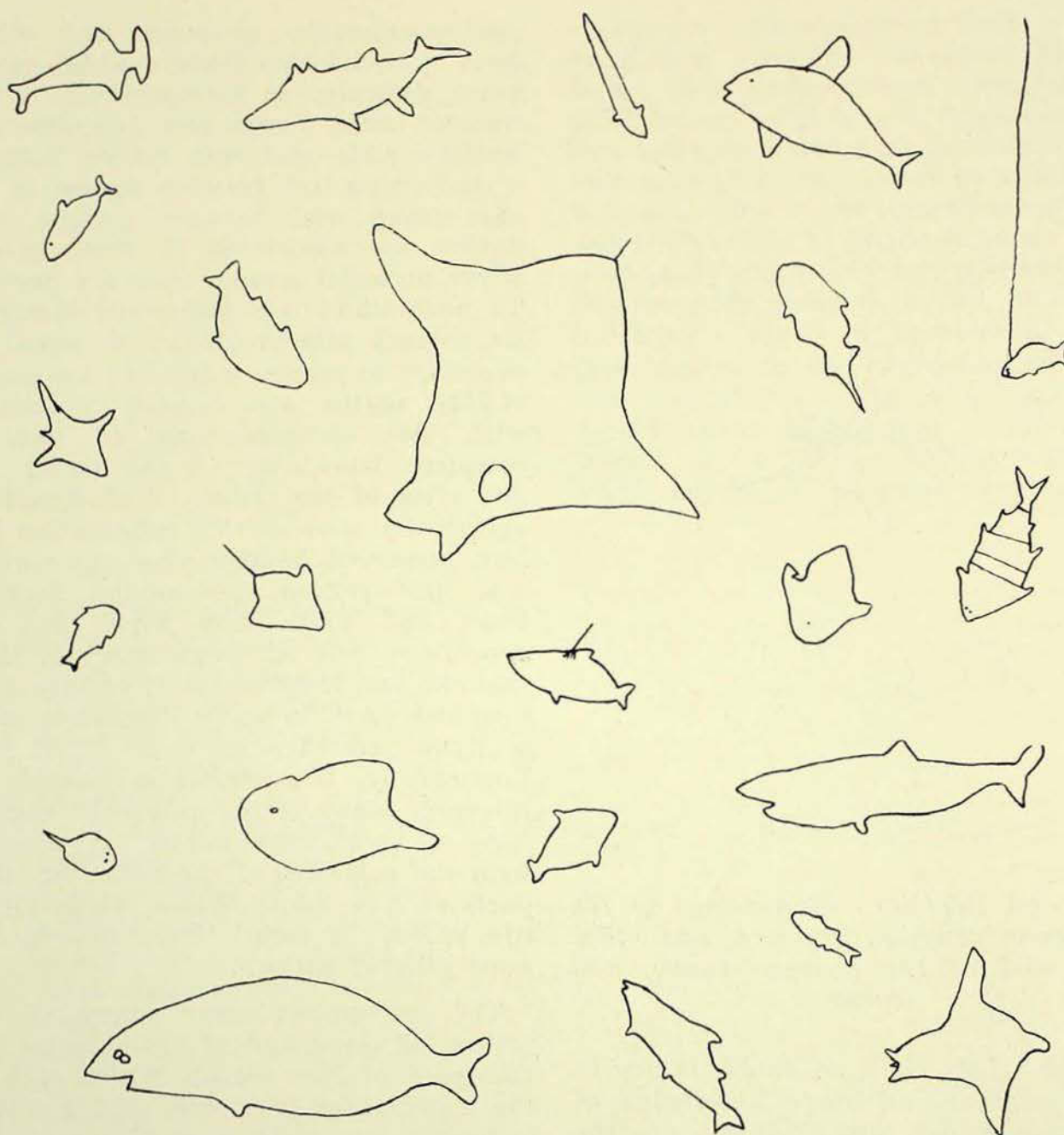
observer. This skill, no doubt, is due to the aboriginal's intimate knowledge of the appearance and habits of the creatures, gained from a lifelong observation of them in his quest for food and, further, in his use of them as ritual symbols. When we consider the medium and the laborious technique, we must admit that the task has been accomplished with admirable results.

An aspect of the significance of these rock engravings which has not yet been thoroughly studied, owing to the fact that a large number of the groups has not yet been recorded, is the relationship of the figures in one group to one another, and of group to group. The figures in most of the groups consist of a heterogeneous mixture of mammals, fish,

anthropomorphs, weapons, and others more uncommon, a feature which causes much difficulty in interpretation. The lines of ovals, human feet, kangaroo and wallaby pads, and emu tracks, indicate a connecting link between figures in the one group and between groups, and figures are associated in those groups where pictorial compositions are present. To understand this important factor in its correct interpretation, it would be necessary to possess a detailed knowledge of the myths and legends associated with the carvings, and to have a complete knowledge of the secret life and rites of the tribes. Unfortunately, practically none of this information has been preserved, because when the country was first settled the conflict between black and white soon wiped out the aborigines, and, although many of their customs and their material culture have been described in early literature, there is little reference to their ritual life. Fortunately, however, it is possible to interpret many of the groups of engravings of ceremonial nature by analogy with the practices of the tribes in other parts of New South Wales, whose ritual life varied in detail, but followed the same general pattern.

The carvings portray many of the totems of clans and of individuals. In this part of New South Wales each of the many clans in a tribe has a totem, and members of the same clan were not allowed to marry. In addition, individuals possessed separate totems of their own. The totem served as a guardian and emblem, but it is not definitely known, although thought probable, that ceremonies such as those of the tribes on the north coast of New South Wales for the increase of the species serving as the totem, were carried out in the area in which the engraving occurs.

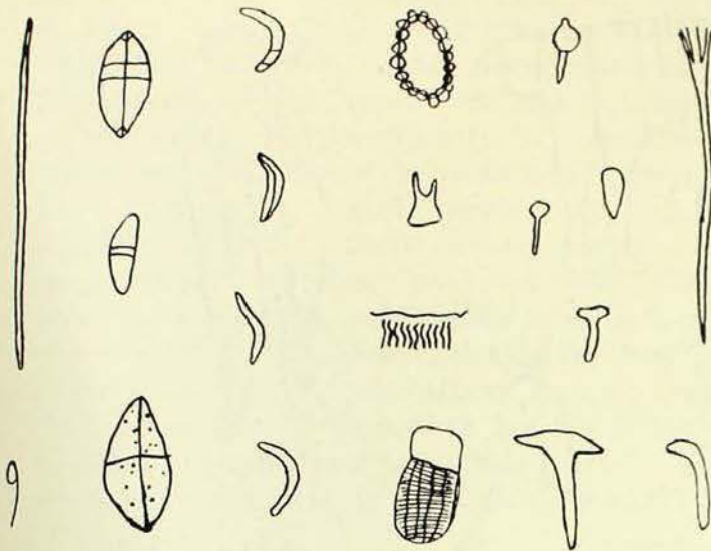
The question might now be asked: What is the antiquity of the petroglyphs? This is difficult to estimate, for several reasons. The earliest carvings have undoubtedly weathered away and dis-



Fish. The engravings of fish include the hammer-headed, tiger, whaler, and other sharks, various rays, sunfish, and many of the species common to the Sydney district.

appeared, because the sandstone into which they are cut is a soft rock which is comparatively soon worn down by the action of wind-blown sand and by water. Moreover, some of the figures are so lightly incised that they are difficult to discern, while others have deep, wide grooves. It is possible that many of the latter were regrooved for ceremonies, since most of the culture heroes are deeply grooved. Notwithstanding these difficulties, many claims have been made

about their origin. Following Hargrave (*Lope de Vega*, 1911, typescript privately distributed), many have attributed them to early Spanish adventurers who came here to look for gold, whilst others give early Asiatic navigators (Vogan, A. J., *Journ. Polyn Soc.*, xlv, 3, 99-101, fig. 1) the credit for them. Attempts have been made to interpret their meaning according to the languages and picture-writing of ancient Egyptian and other classical civilizations. Such contentions are



Weapons and Other Objects. Engravings of (reading from left and down) spear and weevil, three shields, four boomerangs, shell or seed ornament, netted bag, loin fringe, twined basket, hafted and unhafted stone axes, three clubs, multi-pronged fish-spear, and a lil-lil club.

futile for several reasons. Rock engravings occur throughout Australia, not only on the coast as some believe, and one can hardly imagine the early Spanish and Asiatic navigators spending their time in the interior laboriously carving figures in the rocks. *Further, the subjects depicted in Australian engravings, both naturalistic and geometric, are so illustrative of the secret and daily life of the aborigines, as this brief article has shown, that we need go no further to find out who made them.*

Similar rock engravings occur in all continents, and are especially plentiful in Australia, Africa, and America, where the primitive aborigines had no written language, and in each locality the subjects depicted are indigenous in nature. The earliest known are those of the Aurignacian and Magdalenian periods of Europe and Spain, in which the designs are principally naturalistic. Rock engravings comprising geometric designs are associated with the early metal ages in Spain (Obermaier, H., *Fossil Man in Spain*, 1925), and scien-

tific investigation by competent research workers is adding valuable data to our knowledge about their age and cultural associations in Scandinavia, India, and Africa. The occurrence of rock engravings in so many parts of the world is due to the migrations of the peoples of whose cultures they form an element, and by their contact with other peoples the techniques were diffused far and wide.

In Australia several phases of rock engraving have appeared, as follows: 1. Grooving, produced by (a) scratching the rock surface with a sharp stone or hardened stick to make a series of narrow and shallow incisions, and (b) grinding deep grooves with a sharpened stone. 2. Puncturing: making a series of punctures to form an outline of the figure. 3. Puncturing and then grooving of the outline. 4. Hammer-dressing: hammering the whole surface of the figure with a hammer-stone to form an intaglio. Thus, in considering the question of origin or antiquity, we become involved in a mixture of diffusion of techniques and migrations of people, one of a number of similar problems in Oceanic cultural history. Outline grooving occurs in New Guinea, New Caledonia, and Fiji, so that it is not strictly an Australian problem; it may have been brought by an early people who settled throughout the area of distribution, or to one locality from which it diffused, or it may have diffused to Oceania without the migration of people. The intaglio technique in the interior of Australia may be more definitely placed. The technique of hammer-dressing is one which spread through southern Asia, Malaya, and Oceania in early neolithic times (McCarthy, F. D., *Report of 4th Congress of Prehistorians of Far East*, Singapore, January, 1938, now in press). It was employed in Central and eastern Australia for shaping ground-edge axes, and along the Darling River for shaping ground-edge axes, grooved ground-edge axes, millstones, mullers, and cylindrical stones; within this distribution the same technique has been employed to make the intaglio rock engravings, some



Culture Heroes and Enigmatic Figures. No. 7 is a common type of culture hero, depicted with one leg and one arm; he is holding a hafted stone axe. The woman in No. 6 is wearing a necklet, and loin girdles are worn by Nos. 4 to 6, and 8. No. 3 is a large and unusual emu-like figure, and No. 2 an enigma.

of which are of such recent origin that they are not patinated.

Let us consider the motifs. According to Obermaier, the geometrical patterns were developed in Spain by the conventionalization and stylization of the naturalistic drawings. This is not true of all of the geometrical motifs in Australia, although the zigzag motif of Western Australian decorative art is a conventionalized snake. There is no evidence to indicate that the concentric circle so typical of Central Australian

pictographic and decorative art, and of far western New South Wales rock engravings, and the concentric diamond characteristic of eastern Australian decorative art, developed from naturalistic subjects; they no doubt diffused into Australia from New Guinea, where both are common on utilitarian and sacred objects.

Unfortunately, a great deal of mutilation and destruction of these interesting relics has taken place, as pointed out by Professor J. L. Shellshear in a recent

issue of this MAGAZINE (Vol. vi, 1937, p. 169). One of the most serious factors militating against their preservation is the spread of settlement on the outskirts of the city. In practically all instances where homes have been built near groups, the occupants, and especially their children, have added lines, recut the engravings, written and carved their names over them, and otherwise defaced the work of the aborigines. Instead of committing such vandalism, people who live near these valuable relics should appoint themselves guardians and take care that no one is allowed to tamper

with them. Even in our national reserves, groups of rock engravings have been destroyed by road-building operations, and each year more groups are obliterated. It is imperative that the public conscience should be awakened to the need for the preservation of such relics of a past race, for they are of great value to the scientist who understands their meaning and function in the life of the aborigines. The line illustrations have been made and arranged by Miss E. Bramell, after Campbell and from records in the Australian Museum.

THE AUSTRALIAN ABORIGINES: HOW TO UNDERSTAND THEM. By Professor A. P. Elkin. (Angus and Robertson, Ltd., Sydney, 1938.) Pp. xiv + 262, and 20 plates. Price: 8s. 6d.

This splendid book is the product of a scientist who has had unique opportunities to study the life and culture of the Australian aborigines. Professor Elkin has carried out extensive field-work among these people, he is widely acknowledged as our greatest authority on their magico-religious life and social organization, and he has directed Rockefeller Foundation research work in Australia for many years. In addition his interest in the aborigines is not only that of a scientist, but that of a humanitarian also.

A general account of how the aborigines live and of their attitude to their lands is given, the function and place of the family, various social groups, and kinship are then dealt with, followed by a discussion of totemism, the secret life, initiation, magic, and death, in their cultural setting. Professor Elkin has dealt with these aspects of the subject from the point of view of the aborigines, that is, according to their philosophy and attitude, so that the reader is given a deeper insight into their thoughts and mind than has previously been obtainable in book form. Although material culture is only briefly mentioned, emphasis is placed on the manner in which the ritual,

art and daily life are interdependent and interwoven. Thus, the study of the food quest involves the weapons and objects used, their decoration and explanatory myths of the motifs employed, the social implications, and ritual background. The explanation of puzzling customs, such as social avoidances, obligations of marriage and of blood relatives, how wives are obtained and treated, the use of the pointing-bone, and others, should be of great interest to those who have read fantastic accounts of them in newspapers and novels.

Professor Elkin reveals in its proper light a world of mysticism and religious fervour in aboriginal life that will astonish those people whose knowledge of the aborigines is limited to the boomerang and death-pointer. One is impressed with the author's deep respect for, and understanding of, our stone-age folk, and one hopes that missionaries and administrators (not only in Australia but among the Pacific islanders) will heed his constructive advice to adapt their teachings to culture patterns, rather than destroy all that is essential to the happiness of the individual and well-being of the society. In other words, that the teacher should *understand* those to be taught. The book is written in a simple and lucid style, and may be read by the layman or student. The illustrations form a well-selected series.

F.McC.

The Giant Toad *Bufo marinus* in Australia

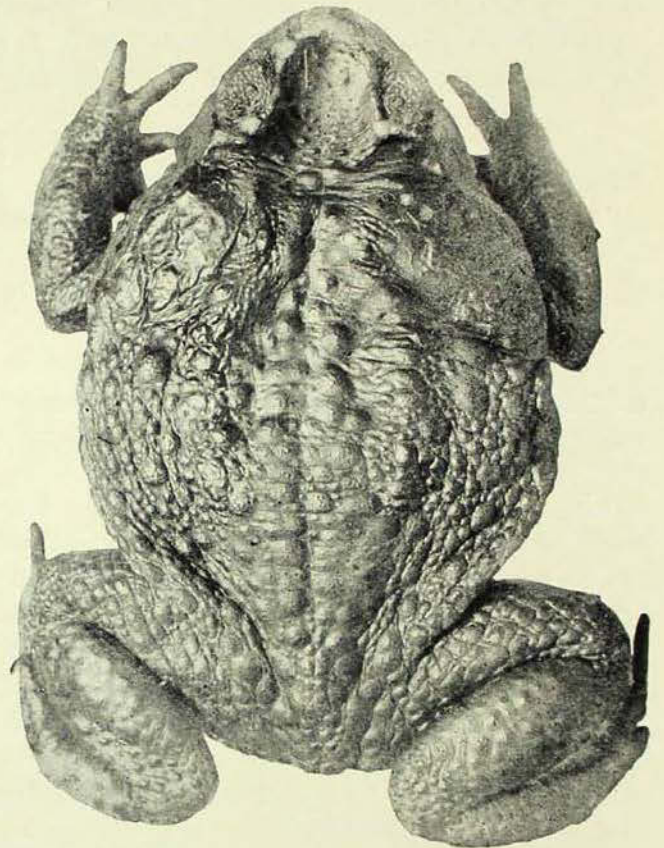
By J. R. KINGHORN, C.M.Z.S.

ABOUT three years ago Giant Toads were introduced into the cane-fields of Queensland in the hope that, when they became established, they would play an effective part in the control of several species of beetles, the grubs of which cause serious losses in the canefields in certain districts. Reports concerning the toad are published from time to time in the *Queensland Agricultural Journal*, *The Cane Growers' Quarterly Bulletin*, and *The Australian Sugar Journal*. As these publications are not readily available to the majority of herpetologists, the following brief résumé should be both an interesting and helpful reference.

Because of the value of the toads in the sugar-cane fields of Barbados, where they have a marked effect on the insect life, they were introduced to Puerto Rico in the year 1920 to control a beetle, the grubs of which were causing considerable loss, and they proved highly successful. From Puerto Rico they were taken by Mr. C. E. Pemberton, entomologist to the Hawaiian Sugar Planters' Experiment Station, to Honolulu, where they multiplied rapidly and became firmly established. Later the toad was introduced to the Philippines, and it was not until the year 1935 that it was imported into Queensland.

The normal diet of the toad consists of all kinds of beetles, cockroaches, mole crickets, weevils, caterpillars, sowbugs, and the like, and it will snap up almost any moving object that attracts its attention.

In Queensland, during the year 1936, observations were made regarding its breeding habits, and, in order to find out how frequently the toads produced eggs during the year, numbered arm-bands were placed on females which were definitely observed laying eggs.



The Giant Toad.

Number 1 produced 16,000 eggs on the 17th March, 1936, and was found depositing a further batch on the 30th May the same year, but as the egg strings were intertwined with those of eight other toads, the mass total of which was 125,000 eggs, the number per individual could not be estimated. There were records of at least 52 egg masses in the Meringa district since November, 1935, but, as only 37 female toads were liberated, it was obvious that some of them had laid more than once. It was later estimated that up till March, 1937,

not less than 1,560,000 eggs were laid, and that approximately 62,000 toadlets had been caught and distributed.

In the annual report of the Bureau of Sugar Experimental Stations, Queensland, 1938, it is stated that the Giant Toad has continued to multiply since its introduction into Queensland and is now present in all sugar areas where "white grubs" cause noticeable damage. Toads are becoming plentiful and are scattering far and wide in the Cairns-Gordonvale district, and are commonly to be seen in fields, around farm buildings, and at night under street lights. It is further stated that, judging by the numbers of immature and adult toads seen, the Experimental Stations should by the end of the year 1938 be in a position to formulate some idea of their probable effect on the Greyback grub pest. Up to the present the toads have been seen eating the greyback beetles under natural conditions, but it will not be possible for some time to determine what the ultimate toll will be, or whether it will be sufficient to ensure comparative freedom of the crops from damage.

At a conference held at Puerto Rico in 1934, Wolcott said:

If conditions in these countries (Australia and Fiji) are at all comparable to those in Puerto Rico, let me now predict that within ten or fifteen years the white grub problems in these countries will be solved.

It may be stated that up till this time the Giant Toad had not been introduced into Queensland or Fiji, though Wolcott apparently thought they had been.

In the *Queensland Agricultural Journal*, 1935, p. 248, Mr. R. W. Mungomery replies to Wolcott's statement in the following terms:

Whilst all of our species of white grubs may not lend themselves to control by the giant toad, and we may not altogether entertain the same high degree of optimism as that displayed by Wolcott, still we have reason to maintain a certain amount of optimism concerning the effect that this toad is likely to have in minimising greyback grub damage in some of our northern canefields. Whether our speculations are fully justified is one of the fascinating problems met with in economic entomology, and time alone will show whether our cherished hopes for the total elimination of grub damage in Queensland canefields will be realised.

It is worthy of note that the introduction of the Giant Toad into Queensland did not pass unchallenged, there being many protests from natural history societies and individual naturalists; the objections were that the toad would not confine its attention to white grubs and similar pests, but, being so large and having the habit of snapping up anything small that moved, it would interfere severely with the natural fauna, such as small lizards, other toads and frogs, or even young ground birds, all of which are of very definite economic value.

There probably is a good deal of justification for these protests, and it would perhaps have been wiser to postpone the liberation of the toads until more searching inquiries as to its habits had been made. By this it is meant that inquiries should have gone beyond entomologists to herpetologists, but the latter are almost invariably overlooked when the creature to be controlled is an insect. It is to be hoped that the toad will confine its attention to insect pests, but our experience with the introduction of birds and other animals in the past, nearly all of which are now declared pests, should make us extra careful before liberating any other kind of animal.

Fiji—A Correction

By A. MUSGRAVE

IN my article on the R. H. Phillips Collection of Fijian Moths Published in the last number of THE AUSTRALIAN MUSEUM MAGAZINE I made two inaccurate statements which I have been asked to correct.

In one instance I stated that the present Government Entomologist of Fiji was Mr. H. W. Simmonds, but in a letter to me Mr. R. J. A. W. Lever, B.Sc., points out that he is now the Government Entomologist and that he took over from Mr. Simmonds in July, 1937. Mr. Lever has also indicated that my statement that "Fiji was ceded to Britain in 1875" is incorrect, and points out that the correct date was the previous October. In this regard I have consulted various works, and it is interesting as well as somewhat amusing that nearly all differ in some particular as to the date of the cession. For example, the well-known work issued by the British Admiralty entitled *Pacific Islands (Central Groups)*, 4th Ed. *Sailing Directions*, vol. ii, 1908, p. 7, states that it was "formally proclaimed a British Colony 1st September, 1875". Stewart's *Handbook of the Pacific Islands*, 1918, p. 185, says, "in 1874 the chiefs formally offered to cede the islands to Great Britain, and sovereignty was proclaimed by Sir Hercules Robinson, G.C.M.G., Governor of New South Wales, on 23rd September, 1874". Stanford's *Compendium of Geography and Travel* (new issue), Australasia, ii, 1908, p. 472, states, "in 1874 Mr. Layard and Commodore Goodenough were sent to report upon the advisability of annexation, and as a result the islands were unconditionally ceded by Thakombau

to Great Britain on the 30th September of that year". Perhaps the most concise and authoritative account is that given in *The Handbook of Fiji*, 1937, pp. 10-11, and which I here quote: "Sir Hercules Robinson arrived at Levuka on the 23rd September, 1874, and on the 10th October, 1874, after several interviews of a most satisfactory nature with the 'King' and Chiefs, the latter made a formal and unconditional cession to HER MAJESTY Queen Victoria of the sovereignty of the islands. Arrangements were made by Sir Hercules Robinson, after the formalities connected with the transfer of the sovereignty had been completed, for the provisional government of the islands until the arrival of the Governor appointed by HER MAJESTY. . . . These provisional arrangements worked well on the whole, although the colonists naturally looked forward to the arrival of Sir Arthur Hamilton Gordon, K.C.M.G., who, soon after the receipt in England of Governor Robinson's despatches, was appointed by HER MAJESTY the first Governor of the new colony. Sir Arthur Gordon arrived at Levuka in H.M.S. *Pearl* on 24th June, 1875, and landed officially on the following day. . . . On the 1st September, the administration of the Government of the Colony was formally assumed by the Governor, and the Charter of the Colony and HIS EXCELLENCY'S Commission were read in the presence of a large concourse of people assembled at Nasova."

I regret the occurrence of the blunders in my article and thank Dr. Lever for directing my attention to them.

Australian Insects

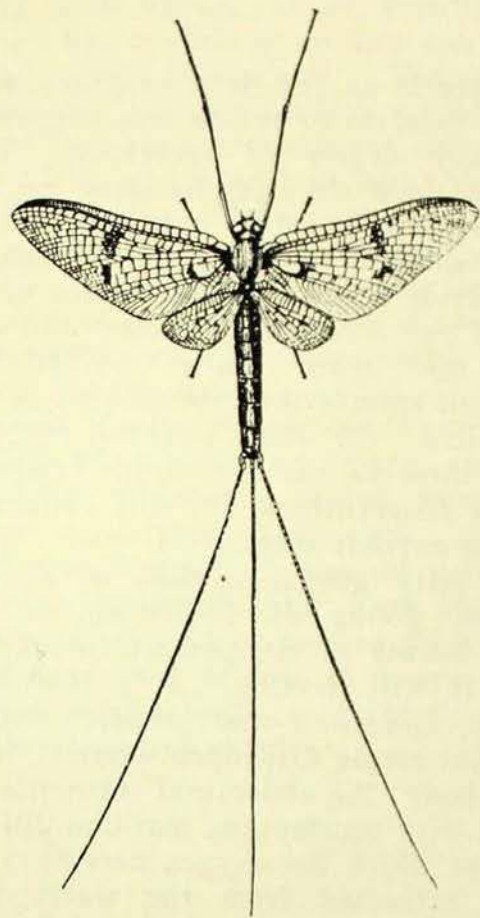
IV. The May-flies

By KEITH C. McKEOWN

THE insects of the order Ephemeroidea (or Plectoptera) are popularly called May-flies, and have a wide distribution throughout the world. Australia in comparison with other lands is not rich in these insects, for, while about 500 species are known from the world, some twenty only have as yet been described from our continent. To the average observer these delightful little insects are largely unfamiliar, and, apart from the angler and those especially interested in the life of our streams, few pay them more than casual attention, yet they are remarkably interesting little creatures, and their life-histories present many curious features.

The association of their name with the Ephemeroidea of Greek mythology applies only to the very brief period of adult life of these insects which is spent above water and which lasts but a few hours, or at most a few days. By far the greater portion of their existence is spent wholly submerged in the running water of rivers and streams, although the nymphs of some species may emerge from the water and cling to the wet rocks under and around waterfalls. The life of the nymph is considerably prolonged, and may occupy, possibly, up to as much as three years.

The eggs are deposited in masses, in a somewhat haphazard manner, in running water, but soon disintegrate and become scattered in the mud or among the water-weeds. In a number of species each individual egg is provided at the ends with a skein of fine yellow threads, which become unravelled and serve to anchor the egg to plant stems or other submerged objects. After about ten days, or even several months, these eggs hatch, and produce small and active nymphs.

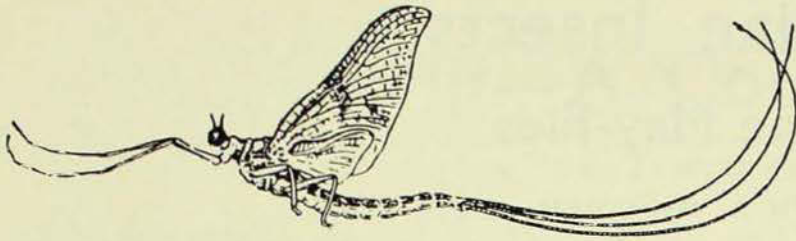


A typical May-fly.

After British Museum.

These newly hatched nymphs are curious, rather emaciated-looking little creatures, which hasten to seek shelter under stones or in crevices in the banks of streams; others again burrow directly into the mud of the stream bed.

Their food is simple, for they are vegetarians, feeding upon algae, the tissues of higher plants, or even upon decaying vegetable matter accumulating at the bottom of pools. Some forms have been accused of carnivorous tendencies,



Male May-fly showing the elongated forelegs, and the manner in which the wings are carried while at rest.

After Comstock.

but there is as yet little evidence available to confirm or refute this suggestion with any degree of certainty. With plentiful food the nymphs grow rapidly, and, with increasing bulk, cast their skins frequently. No definite information is available regarding this aspect of the lives of our Australian species, and even with the more fully investigated European species the information is still incomplete. Sir John Lubbock recorded twenty-three moults in *Chloeon dipterum*, but his observations did not commence with the earliest stages.

The fully grown nymph is a drab creature, giving no indication of the fragile beauty of the perfect insect into which it will develop. It is soft and delicate, elongated and slender, with a head that seems disproportionately large for its body; the abdominal segments are fringed with overlapping leaf-like gills by means of which the oxygen necessary for life is extracted from the water that bathes its body. Three slender filaments, margined with fine hairs, project from the extremity of the body. In the well-developed nymph wing-pads are prominent, but in the younger forms these pads are wanting or very small; they are developed during the successive moults, usually appearing when the insect is about half-grown.

When the nymph is fully developed it swims to the surface of the water or climbs up the stem of some convenient aquatic plant which projects above the water. During this journey many fall a prey to voracious fish, which gulp them down in enormous quantities. Once at the surface the insect behaves in a really remarkable manner; it gulps air into its

body until the alimentary canal is greatly distended with it, and this condition is retained in the perfect insect. This renders it lighter and so adds to its powers of flight, and also makes it extremely buoyant when the critical time arrives for it to deposit its eggs. This lowering of the insect's specific gravity is accomplished only by the sacrifice of its power of feeding—the adult May-fly never takes food.

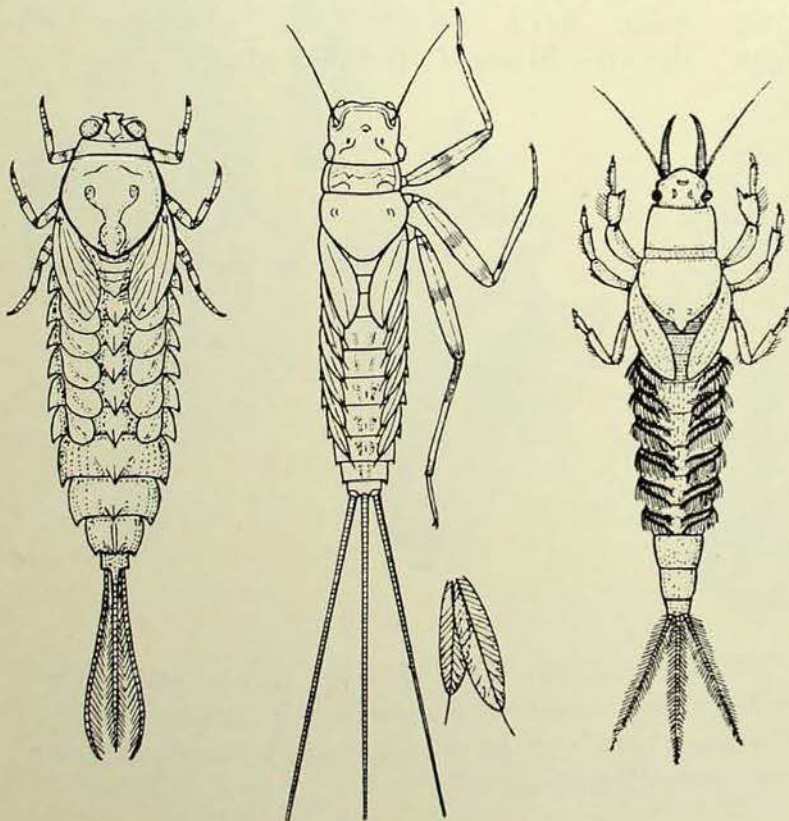
But to return to the emergence of our May-fly. With something of a struggle the nymph forces its way through the surface film and floats high and dry upon it. Its nymphal skin splits, and the enclosed insect wriggles rapidly from its rent husk and flies away, leaving the empty skin floating on the water until wind and waves swamp the frail vessel. When we consider the length of time necessary for other insects to dry and harden their wings after their emergence from the pupal or nymphal skin, the rapidity with which the newly emerged May-fly takes flight is truly amazing. Sir John Lubbock has written: "From the moment when the skin first cracks not ten seconds are over before the perfect insect has flown away."

The story is, however, not yet told. The insect has yet another surprise in store for us. The May-fly that has emerged from the nymphal skin and rests upon some rock or tree-trunk has the wings dull and frequently clouded or blotched; it is not yet mature. It is encased in another skin which must be cast before it is fully adult—a skin that not only covers the body, but completely encloses the wings as well. In this state it is termed the "sub-imago". This next stage

of the transformation may occur within a few minutes of emergence, or may be deferred for several hours or even for some days. This sub-imaginal skin, finer than the sheerest tissue, splits, and the true adult or imago withdraws its legs and wings from their casing, and flies off, leaving the empty skin, perfect in every detail, clinging to its support. This remarkable condition is unique among the May-flies and does not occur in any other group of insects. The May-fly has now left its days of feeding behind it, and is ready for the dance of love.

The perfect insect is one of the daintiest and most beautiful insects imaginable, so fragile that a touch will crush it. It is large-eyed, and rests with its fore-legs extended straight before it; in the male these limbs are often exceedingly long. The two pairs of clear gauzy wings are held erect over the body, reminding one of the sail of a yacht. The front pair is large and fan-like, the hind small and inconspicuous. The antennae are small, but as though to emphasize their lack, and to complete this delightful little creature, three slender filaments project from the hind extremity of the body.

The swarming, or nuptial flight, of May-flies is a sight to linger in the memory. I have been fortunate enough to witness several of these flights on certain occasions on the Tuross River, New South Wales. With the coming of dusk the adult May-flies, which have been resting upon the rough bark of the trees or concealed in hollows in their trunks, take wing and engage in an erratic flight, which has a curious up and down movement, over the water. The whirling mass of insects consists primarily of males, but the females hover about on the outskirts, and ever and anon these will dash into the thickest of the swarm to be seized by the long forelegs of their mates. These pairs abruptly leave the dance for the seclusion of the overhanging vegetation. Marriage seems to mean death for the males. As the evening progresses, the insects become fewer, and the water of the stream more and more dimpled where the mated females are busy depositing their eggs. In some instances egg-laying may be deferred to an evening or two later. Such flights may occur on several successive evenings, but I believe that seldom or never does an insect survive to attend more than one of these scenes of carnival.



Three types of May-fly nymph. A free-swimming form; a rock-dwelling nymph, with two of the gills enlarged; and a burrowing type. After Tillyard.

One of the best accounts of the swarming of May-flies is one of the earliest, that of Réaumur. After describing the behaviour of insects which he had confined in a bucket, he continues:

So far I had taken no notice of what was going on by the river, but now the exclamations of my gardener, who had gone to the foot of the stairs, attracted my attention. I then saw a sight beyond all expectation. The Ephemerae filled the air like the snow-flakes in a dense snow-storm. The steps were covered to a depth of two, three, or even four inches. A tract of water five or six feet across was completely hidden, and as the floating insects slowly drifted away, others took their place. Several times I was obliged to retreat to the top of the stairs from the annoyance caused by the Ephemerae, which dashed in my face, and got into my eyes, mouth and nose.

It is singular that nocturnal moths, which shun the light of day, should be attracted by the lights in our rooms, and still more singular that these Ephemerae, which emerge only after sundown, and perish before sunrise, should be drawn so powerfully towards a lantern. The person who held the light had a bad time of it; in a few moments he was covered with the flies, which came in all directions as if to overwhelm him. The luminous sphere about the light was crossed at all angles by the orbits of the circling insects, which after performing one or two revolutions fell to the earth.

After half an hour or less the swarms were less dense, and by ten o'clock only a few scattered Ephemerae could be seen on the river, while no more came round the light.

After the nuptial flight egg-laying takes place with little delay, the eggs

being rapidly extruded in two yellowish masses. The May-flies flit quickly over the water, dipping the tip of the abdomen beneath the surface to wash off the adhering eggs; others alight upon the water for this purpose, or even descend beneath the water to lay their eggs upon or under stones. Some float again to the surface, but most of them die without reappearing. It is at such periods that the trout consume them in countless numbers.

The Australian May-flies are divided into four families, the Siphonuridae, Ephemeridae, Leptophlebiidae, and the Baetidae. The Leptophlebiidae is our dominant May-fly family. *Attalophlebia costalis* is the commonest of our May-flies, a rich brown species with extraordinarily long tail filaments. Of the Siphonuridae, members of the genus *Ameletus* occur in Blue Mountain streams, and of *Coloburiscus* on Mt. Kosciusko and in Victoria. Larvae of an undescribed *Ichthybotus* (Ephemeridae) occur in the Fish River, New South Wales. Baetidae are represented by a few small northern forms.

Remarkably little is known as to the details of the lives, or even of the nymphal forms, of our May-flies, and a wide field awaits the observer who devotes himself to their study.

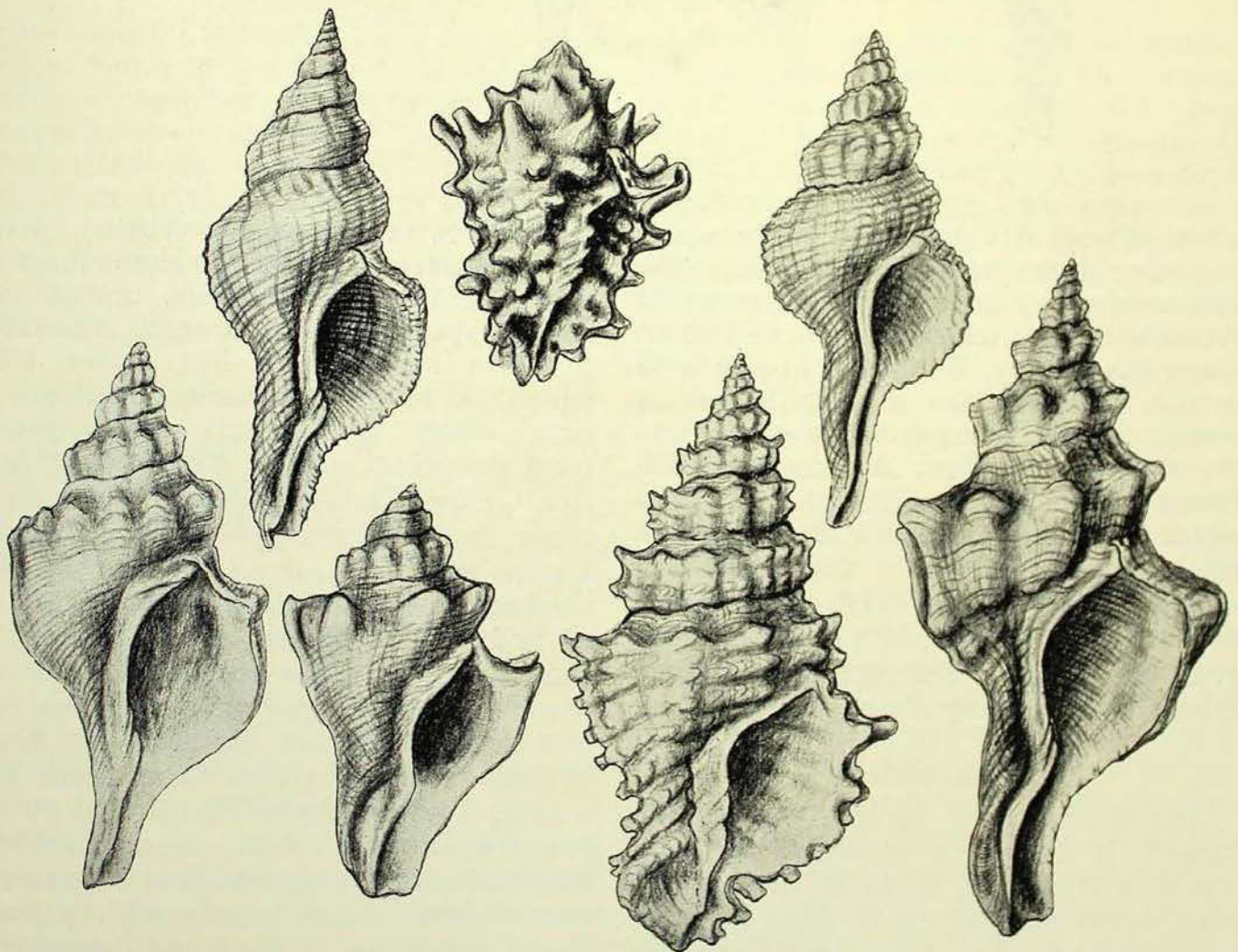
Australian Shells

Spindle and Band Shells, Whelks, and the False Trumpet Shell

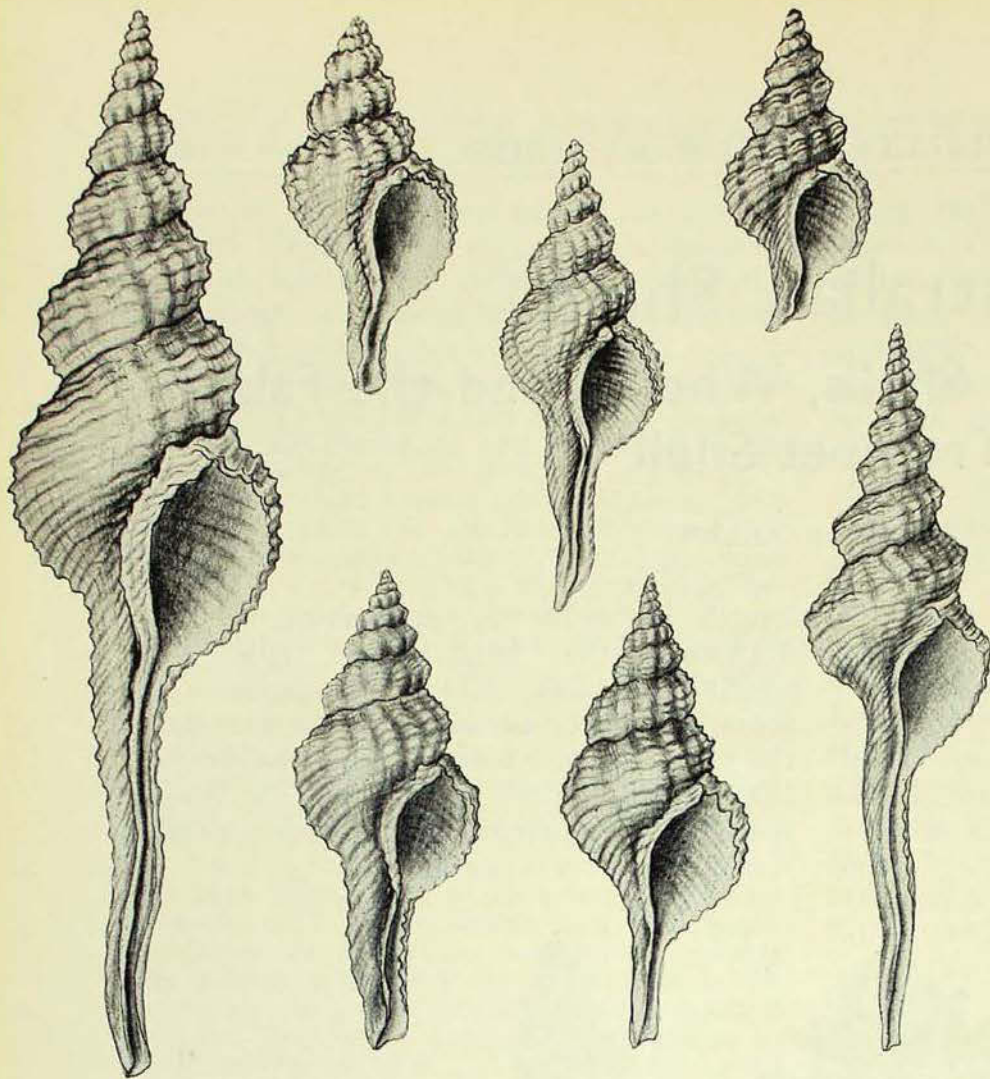
By JOYCE ALLAN

SPINDLE and Band shells comprise a large group of species which vary considerably in shape and size, although the shells retain more or less their characteristic spindle shape. Chief discriminative characters used in identifying and classifying these shells are the

length of spire in proportion to the diameter, the longitudinal ribs and revolving striae, which all possess to some degree, the presence of tubercles, and the presence or absence of a shoulder on the whorls. Some species will be found with a long narrow true spindle shape,



Spindle, Band and Whelk shells. In the top row, from left to right, are Pleuroploca filamentosa, Vasum turbinellum, and Colus australis; in the bottom row, Pleuroploca australasia coronata, Volema cochlidium, Altivasum flindersi, and Pleuroploca trapezium.



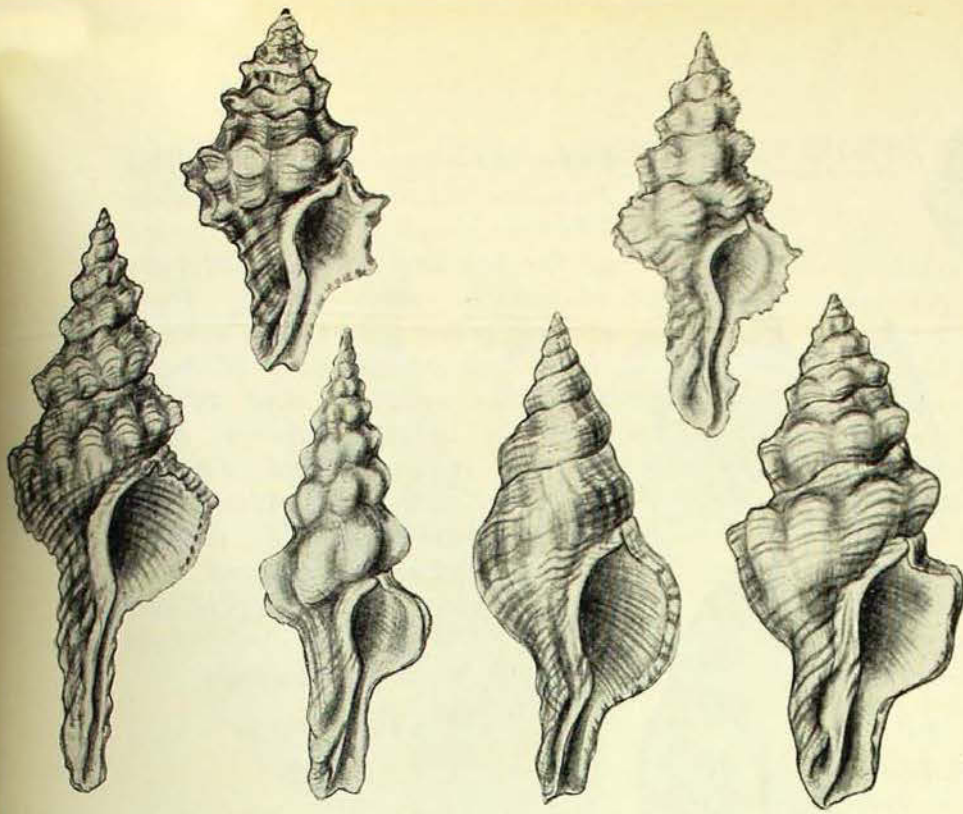
Spindle Shells. The large one on the left is *Colus novae-hollandiae*, and the three in the top row, from left to right, are *Propefusus undulatus*, *Colus sinovellus* and *Colus consetti*; in the bottom row the three are *Fusinus crebriliratus*, *Propefusus pyrulatus*, and *Colus colus*.

while others will possess a more squat and strongly shouldered character. The former are very graceful shells, many of the smaller ones resembling each other in shape and colour. They vary in size from a little over an inch to nine inches in length, and in colour from pure white to all shades of yellow, brown and red-brown. The family Fasciolariidae, to which the Spindles and Band shells belong, has practically a world-wide distribution in tropical and sub-tropical waters. Fossil forms, of which there are over three hundred different kinds, exceed the living species by about two hundred.

SPINDLE SHELLS.

Among the true Spindle shells, the largest is *Colus novae-hollandiae* from southern Australia, a white shell about nine inches long which is often brought up in trawlers from depths ranging to 80 fathoms, and empty shells are occasionally found washed up on beaches of southern New South Wales. Species resembling this are a narrow, slightly

smaller form from the South Pacific, *Colus colus*, and two other shells from the Indo-Pacific, *Colus nobilis*, and a very narrow species, *Colus forceps*. The latter two are not figured, but *Colus colus*, which is, has conspicuous shoulders to each whorl immediately separating it from *novae-hollandiae*. There are several small, closely related Spindle shells about three inches long which can be distinguished from one another by the thickness of their shells, pronouncement of nodules and lines, and the shape of their mouths. These are *Colus sinovellus* dredged in Sydney Harbour, *Colus consetti* from the south coast of New South Wales, *Propefusus undulatus* from Tasmania, *Fusinus crebriliratus* and *Propefusus pyrulatus*, which occur in South Australia, and a Queensland representative of these, *Colus boardmani*. Of these, *Colus sinovellus* is the most elongate in shape. A stouter, more coarsely sculptured species, *Fusinus nicobaricus*, has conspicuous brown markings, and duplicates the nodules on the shoulders



Band shells. The two top species are Latirus polygonus and Latirus recurvirostris, and the four in the lower row Fusinus nicobaricus, Latirus nodatus, Pleuroploca ferruginea, and Latirus gibbulus.

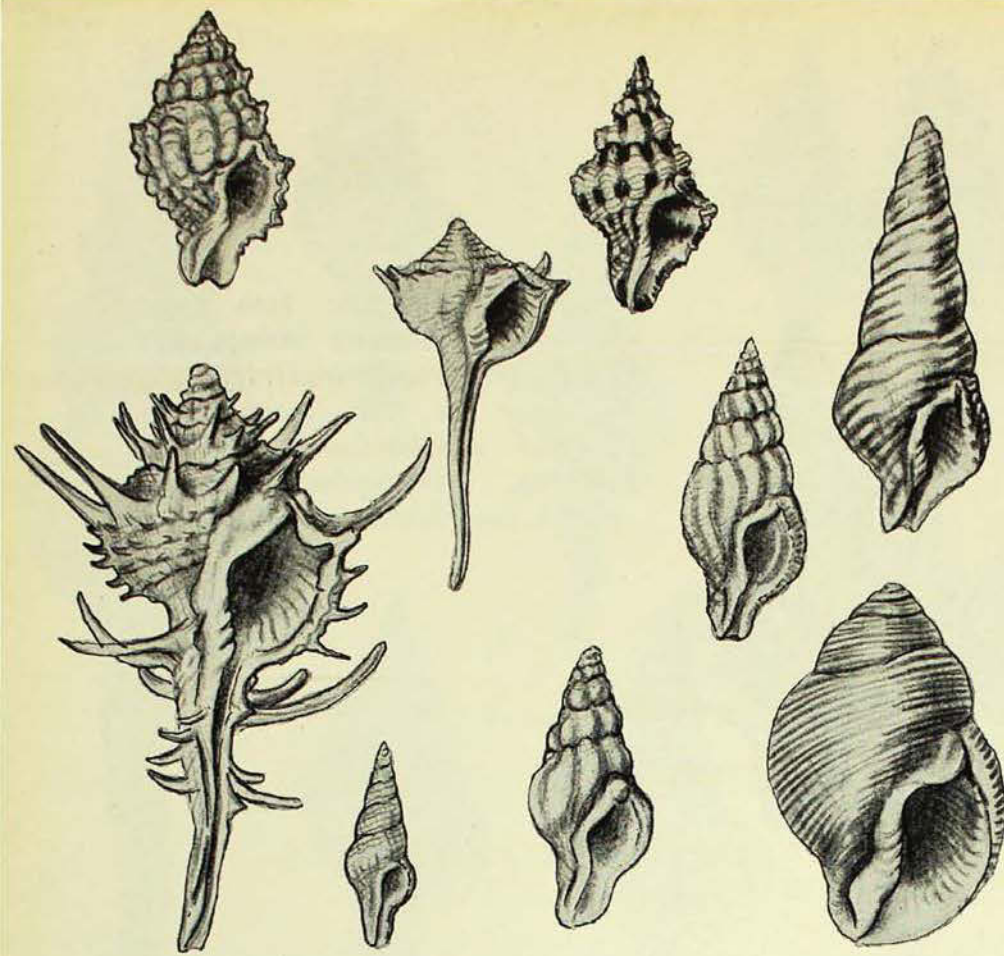
of the whorls; it is about five inches long and is found in the islands of the South Pacific. Another solid species, *Colus australis*, from southern Australia, is broader than the average Spindle, and the revolving striae on its body whorl are more prominent than the longitudinal ribs, breaking the latter into tubercle-like structures at their crossings. This species is about four inches long.

BAND SHELLS.

The next group of the family Fasciolaridae embraces those members which do not differ essentially in their structure from the previous spindle forms, but their spires are usually shorter, their body whorls more swollen, and they have oblique plaits near the fore-end of the columella. These shells are sometimes known as Band shells, Spindles (although they differ from true Spindles), or Whelks, a name used for several groups of heavy shells.

They can be easily recognized, and, owing to their strongly marked characters, are also easy to distinguish from one another. The two best-known species are *Pleuroploca filamentosa*, a species four to six inches long, dark reddish brown in colour with close, raised, red revolving lines inside the lighter coloured mouth,

and a heavier, very nodulose relative, *Pleuroploca trapezium*. The former species occurs throughout the Indo-Pacific, reaching as far as Queensland, but the latter has not so far been found in Australian waters, its range being restricted to the Indo-Pacific. The most common southern Australian species is *Pleuroploca australasia coronata*, fine examples of which can be obtained by dredging. It grows to a length of six inches and varies considerably in the angles of its whorls and the strength of its nodules. In the spring and early summer, egg masses, bunches of beautifully shaped, creamy pink, bell-shaped capsules with fluted edges, are found attached to weeds, old shells and rocks in rock pools of southern Australia from New South Wales to Western Australia. Often the adult is found lying alongside these or may even be seen in the process of laying them. The capsules, which vary from a half to an inch in length, each contain several embryos, and dozens may form a bunch. This species is also known as the Australian Tulip shell, or the Short-Spindle. In Western Australia a dark brown slim form of *Pleuroploca filamentosa*, with brownish yellow lines in the mouth occurs. This is *Pleuroploca ferruginea*.

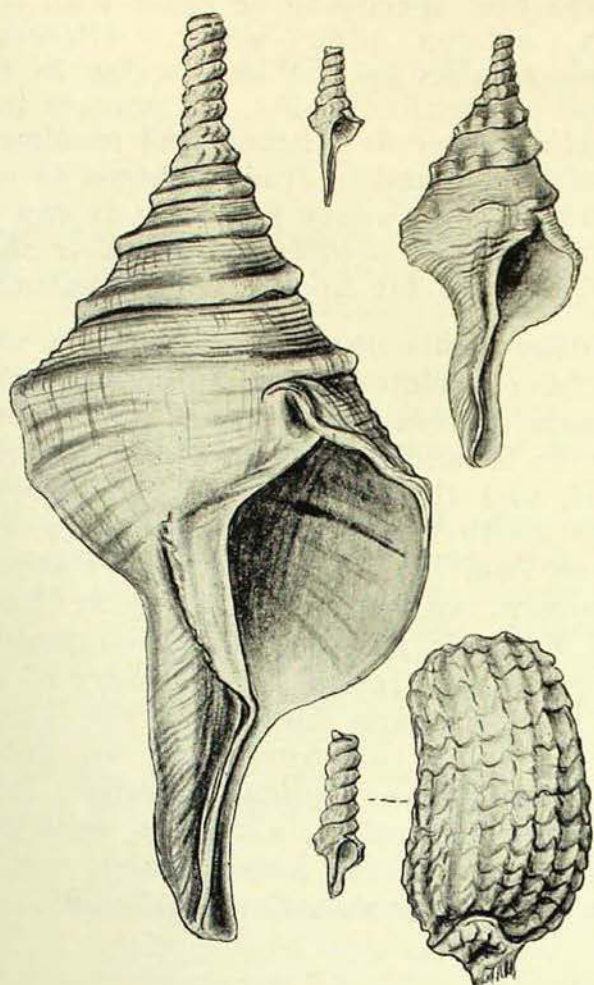


Some members of the families Fasciolaridae and Vasidae. The two small whelk-like forms at the top are, left, *Peristernia nassatula*, and, right, *Peristernia australiensis*. Between these two on a lower plane is *Tudicula spinosa*, and to the right of it two species, *Peristernia iricolor* and *Latirus turritus*. In the bottom row, the large spiny shell on the left is *Tudicula armigera*, and, next to it, *Latirofuscus spiceri*, *Nodopelagia brazieri*, and *Latirolagena smaragdula*.

Another group of this family includes narrower shells than those of the previous group, and their longitudinal ribs are broken up more or less into nodules; in most cases they also have a longer canal. Two of these, *Latirus polygonus* and *Latirus recurvirostris*, the former a dark brown and white shell with a white mouth, the latter pale orange with a pinkish yellow mouth, are found in the Indo-Pacific, extending into Queensland, and in the case of *Latirus polygonus*, even to north-west Australia. A pretty South Pacific species, *Latirus nodatus*, has an orange brown epidermis covering its light yellow exterior, and this together with its rosy pink mouth and peculiar elongated nodules makes it easy to recognize. Another Queensland species, *Latirus gibbulus*, a polished orange brown shell encircled by chestnut brown lines which usually go in pairs, and with a yellow pink mouth, is a heavier shell than the previous ones. The five species figured here vary in size from two and a half to three and a half inches long. The two remaining ones of this group dealt with are *Latirus turritus*, a South Pacific Island species which occasionally comes into Queensland waters, and *Latirofuscus spiceri*, a very small Tasmanian species. The former,

which grows to over two inches in length, can be recognized by its turret shape, revolving ridges of chestnut on a reddish-orange background, and a yellow mouth. The latter is only about an inch or a little more in size.

Several small species, slightly more than an inch long, belonging to the family Fasciolaridae, occur in the South Pacific and north Australia, and as these are fairly common they are also figured. They can be identified with ease, as each has outstanding characters. A species found commonly on the coral reefs of the Great Barrier Reef, *Peristernia australiensis*, has dark brown blotches ornamenting the white shell between its ribs, and brown bands within the mouth; *Peristernia nassatula*, a light yellow-brown shell, has a violet coloured mouth; and *Peristernia iricolor* has elongated nodule-like ribs, yellow brown in colour, and a pale rose mouth. A small species about an inch long, *Nodopelagia brazieri*, is found in northern New South Wales. It is yellow brown with lighter ribs and looks rather like a smoother *iricolor*. A very common South Pacific Islands and Queensland shell, *Latirolagena smaragdula*, is also figured. It is almost egg-shaped, chestnut brown coloured



The False Trumpet shell, Megalatractus aruanus, with an egg-mass, a young shell from it, and above two more stages in the growth of the False Trumpet, showing the difference in the shape of the young and adult. The apex of the adult shell is more often missing than attached to the shell.

encircled by numerous narrow equidistant white lines, has a white mouth, and grows to almost two inches long.

THE FALSE TRUMPET SHELL.

The largest gasteropod shell in the world, *Megalatractus aruanus*, which is found in north Australia, can be mentioned here. In adult specimens, which may reach just on two feet long, the apex is in almost all cases decollated, curtailing the length, it is estimated, by about three-quarters of an inch. When

alive this shell is covered by a brown epidermis, which peels off dry specimens enabling the shell to be freed of it without difficulty. The cleaned shell is beautifully smooth, solid and buff-yellow in colour, making a striking specimen for a collection. Should it be so desired, the epidermis can be kept firm by smearing it with vaseline, a smooth layer of which over any shell will preserve it. The islanders of Torres Strait use this shell in their ceremonies and as a water carrier; they also manufacture the shell into personal articles and eat the animal.

One of the most interesting things about the species is its remarkable egg case, a large rectangular tough mass of rather flattened fan-shaped capsules, about eight inches long, four inches broad and yellow in colour. The capsules are tightly packed one on top of the other, and fluted ridges on each side give a longitudinal ridged effect to the whole egg-mass. The young, long, narrow, seven-whorled shell which eventually emerges from the capsule in no way resembles the adult. It forms the apex of the growing shell, but becomes knocked off in most cases in its adult stage. The range of the False Trumpet shell is from near Fremantle round the north of Australia to Masthead Island, Capricorn Group, Great Barrier Reef, north-east coast of Australia, but is naturally fixed only on specimens collected, and it may at any time be found to extend further.

Confusion has arisen at different times in finding the right family in which to place the False Trumpet shell. Several authors have moved it from one to the other closely related families, and in the family Fascioliidae it seemed out of place, as it is the only shell of its type in the Indo-Pacific, its nearest relative for size being the true Trumpet shell. In the latest work available on the classification of the whole molluscan phylum, the *Handbuch der Systematischen Weichtierkunde*, by Professor Johannes Thiele, the species has been placed in the family Galeodidae, close to the family Fascioliidae.

WHELKS.

Amongst the univalves we frequently meet groups of heavy, often elaborately sculptured shells which go under the popular name in Australia of Whelks, though they may be very widely separated in their classification. This is unfortunately due to the want of a better popular name for some of them, so that we find the large False Trumpet shell sometimes called the Giant Whelk, and, on the other hand, the small nobbly shells found in great numbers along the rocks at low tide round Sydney and on other parts of the coast, which prey on the oysters and other shells, are called the Boring Whelks. The Whelks under discussion here belong to the family Vasidae. They are a mixed group of varying shape and size, and are inhabitants of tropical and sub-tropical waters. Numbers are found throughout the Indo-Pacific and some are common on the reefs of the Great Barrier Reef. As several are very much alike, only the better known and more distinctive forms of the family are figured and dealt with in this article.

The first species to be dealt with is a rare, salmon pink whelk, *Altivasum flindersi*, dredged in deep water in the Great Australian Bight. It reaches to a length of over five inches, and specimens have been found in from eighteen to one hundred and twenty fathoms; it can be quite easily recognized, as no other shell like it is so far known from Australia.

Other shells of the family are a very heavy, chocolate-banded spinose species, *Vasum turbinellum*, from the South Pacific Islands and the Great Barrier Reef, and three species of short-spined, long-canalled shells belonging to the genus *Tudicula*. Two of these, *Tudicula armigera*, an exceptionally spiny form, and *Tudicula spinosa*, with a suggestion of spines only round the periphery of the body whorl, are found on the Great Barrier Reef of Australia; an intermediate species, *Tudicula inermis*, from Western Australia, is totally spineless, and is not figured here. These species can be recognized without difficulty.

A GALLERY OF GUM TREES. By A. W. D'Ombraïn. (Australasian Medical Publishing Co., Ltd., Sydney, 1938.) Svo, pp. 53, with 21 coloured plates. Price: 17s. 6d.

This elegantly prepared little book would make an acceptable gift for anyone who wishes to know the names and individual features of the most typical representatives of Australia's magnificent host of gum trees. Dr. D'Ombraïn has not attempted to compile a laborious text-book on the subject, but has selected for description twenty-one of the commonest varieties of eucalypts found in New South Wales, particularly in the vicinity of Sydney. The popular as well as the correct scientific name of each species is given, together with a general idea of its distribution, and a note on its commercial properties. Since the main purpose of the book is to serve as an

attractive guide by means of which the various trees may be readily recognized, the author has gone to no little trouble to point out the remarkable seasonable changes in appearance which make identification difficult. Each description is accompanied by an illustration in colour, the work of Miss Tydfyl Evans.

Included in the book are some interesting notes on the diet of that amiable inhabitant of Australia's eucalypts, the Koala or Native Bear. Dr. D'Ombraïn makes a plea for the more active protection of these engaging little creatures, who are threatened with complete extinction owing to the destruction of vast areas of forest lands.

A Gallery of Gum Trees is artistically printed in deep sepia on heavy cream coloured paper.

N.B.A.

The Story of Crystals

By T. HODGE-SMITH

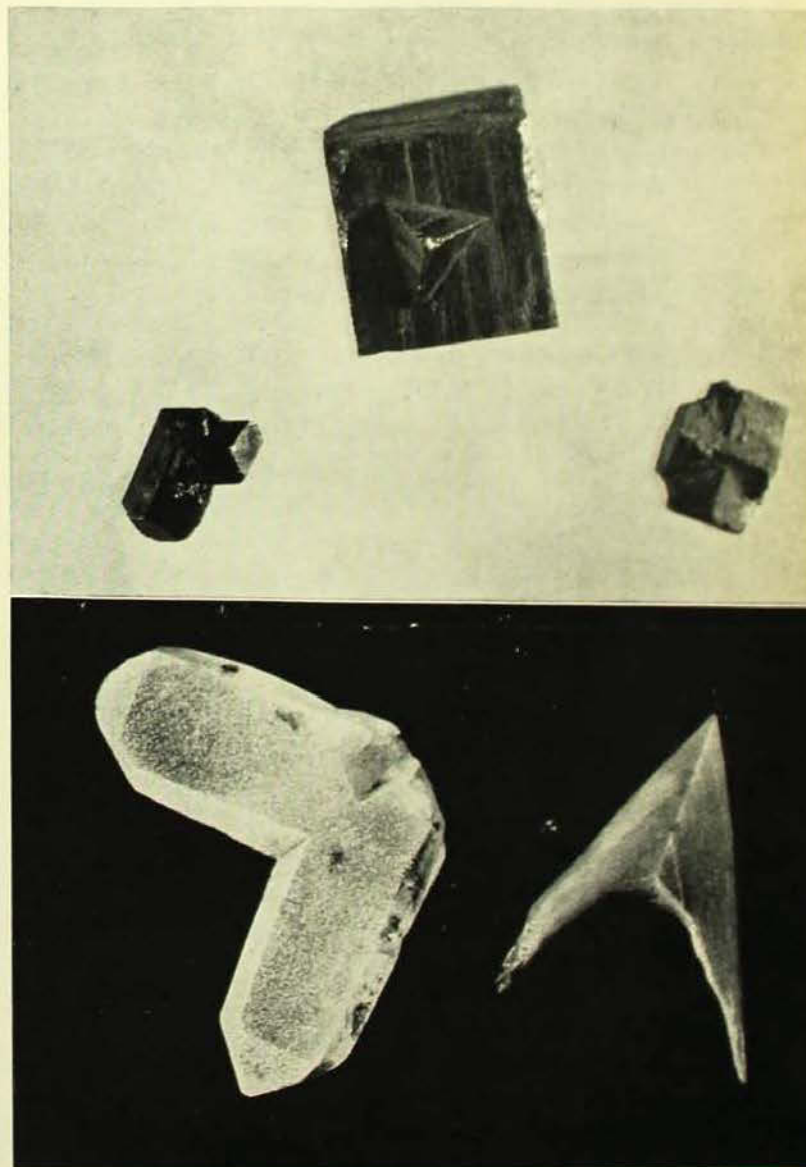
THE solid substances of the inorganic world may be divided into crystalline and non-crystalline material. Of the crystalline material most substances, under suitable conditions, are able to form solids which are bounded by perfectly flat faces. Such solid bodies are called crystals.

One of the fundamental differences between the living creatures and the inorganic world is that the former are able to reproduce their kind. Although crystals cannot do this, they do possess some points of resemblance to the living creatures. The newly born individual of a living species will have characters which are fundamentally the same as those of all other infants of that particular species, but will differ specifically from those of all other species. So it is with a newly formed crystal; it will have characters that are the same as those of all other crystals of that particular substance but are fundamentally different from those of crystals of all other substances.

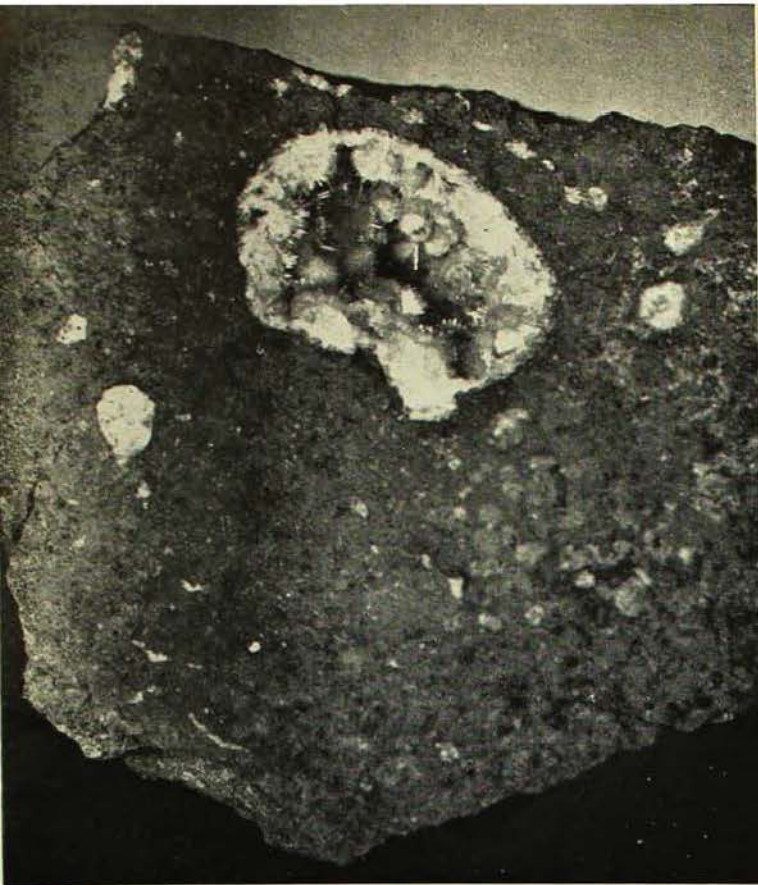
Just as environment produces differences in form, colour and size in the one living species, so it produces similar variations in crystals. Among living things environment may slowly produce an entirely new species from an

already existing species. Among crystals it may produce immediately a new species from the one substance.

If a living creature be not fed it cannot grow but will die and decompose. The crystal, too, needs food to enable it to grow, but it is already dead and will not decompose merely because its food supply has ceased. Some crystals in the Museum are over one hundred million years old and are as perfect today as when they were formed.



A collection of twins. Top row: Staurolite twin, Cloncurry, Queensland. Interpenetration of pyrite, Piedmont, Italy. Knee-shaped twin of Rutile, South Australia. Bottom row: Japanese twin of quartz, Emmaville, New South Wales. Arrow-head twin of cerussite, Broken Hill, New South Wales.



A steam cavity in solidified lava lined with zeolites (natrolite and analcite) from Ardglen, New South Wales.

Twins and abnormalities are other features common to crystals and living creatures. Probably these points of similarity are purely superficial, but there they are.

THE BIRTH OF A CRYSTAL.

Many substances when they pass into the solid state from either fusion, solution, or gas, under suitable conditions form crystals. Thus in certain reservoirs of molten rock, called magmas, buried far below the earth's surface, octahedral crystals of chromite will form very shortly after the slow cooling of the molten mass commences. For a time they may move about in the still liquid magma, sometimes segregating to form irregular masses. As cooling proceeds these crystals are caught in the solid rock. So we find them scattered throughout the rock when it is exposed at the surface by the action of earth movements and erosion.

If you have seen lava flowing from a volcano you will have noticed clouds of steam rising from the slowly moving mass. The rock quickly solidifies and some of the steam rising as bubbles in the

lava is permanently entrapped in the solid rock. Subsequently if the rock is broken open these steam cavities will be seen. Not infrequently they are lined by beautiful crystals of hydrous silicates known as zeolites. They have crystallized from the vapours that formed the cavities. The rock itself looks like a dense hard mass, but under the microscope it will be seen to consist of a beautiful mosaic of tiny crystals of felspar, augite, and perhaps olivine.

The Great Salt Lake, Utah, U.S.A., provides a very striking example of crystallization. In the winter time the cold waters of the lake are unable to carry in solution the large amount of sodium sulphate contained in the water. Consequently large masses of sodium sulphate crystals are formed, which disappear in the summer time when the water is warmer. During the summer a considerable amount of water is lost by evaporation. This causes sodium chloride to form a dazzling white mass of crystals which in turn disappear in the winter.

Sometimes crystals develop in solid rocks under conditions of extremely high pressure that exist at great depth below the earth's surface. In Alaska beautiful crystals of garnet are found in the schist rock, and these have been formed in this way.

Nearly every limestone cave has its "Gem Casket", consisting of beautiful calcite crystals. These are formed because the solution containing the calcium carbonate, of which calcite is composed, loses a gas, carbon dioxide. Without this gas the water cannot retain the mineral in solution, and so a crystal is born.

THE GROWTH OF A CRYSTAL.

We have already noticed that when crystals form from a state of fusion then the slower the cooling the larger the crystals. Most of the best-developed crystals are found in hollows and fissures of rocks of all kinds. These hollows, often found in the lode material of mines, are called vughs by the miners. Water, either derived from the deep-seated magmas or



Ghost quartz. Wallaroo, South Australia.

of atmospheric origin, carrying minerals in solution, finds its way into these vughs, where ideal conditions exist for the growth of crystals. The vugh becomes filled with solution, when practically no circulation exists, and a continuous supply of the crystallizing material is brought to it in solution.

One of the best examples of this that I have seen is at the Garibaldi Gold Mine, Lionsville, New South Wales. Here, separated from the lode channel by a thin wall of rock, was a large hollow which when opened was found to be full of water and lined with large crystals of calcite, some of which could be weighed by the hundredweight. The lode channel consisted mainly of quartz and calcite together with some pyrite, and, of course, a little gold. Surface waters percolating down through this channel found their way into the hollow and filled it. Dissolving the calcite of the lode channel in its downward journey, the water brought a continuous supply of calcium carbonate to the hollow, and so these huge crystals of calcite were enabled to grow.

Large crystals of quartz, some measuring more than two feet in length and over one foot in diameter, are found in vughs of the siliceous pipes and veins carrying bismuth and molybdenite at Kingsgate, New South Wales. The solutions came from the magma which now forms the granite of the New England District. These magmatic solutions are

usually very dilute, so that it must have taken a long time for these quartz crystals to grow to their present size. Sometimes the supply of solution is temporarily cut off, when the crystal will stop growing. Quartz when pure is colourless, but it is seldom pure in nature. If the supply of solution is restored, the crystal will start growing again. If in addition the second solution is purer than the first the new growth will be more transparent than the previous growth and the crystal will have the appearance of a crystal within a crystal, and is called "ghost quartz".

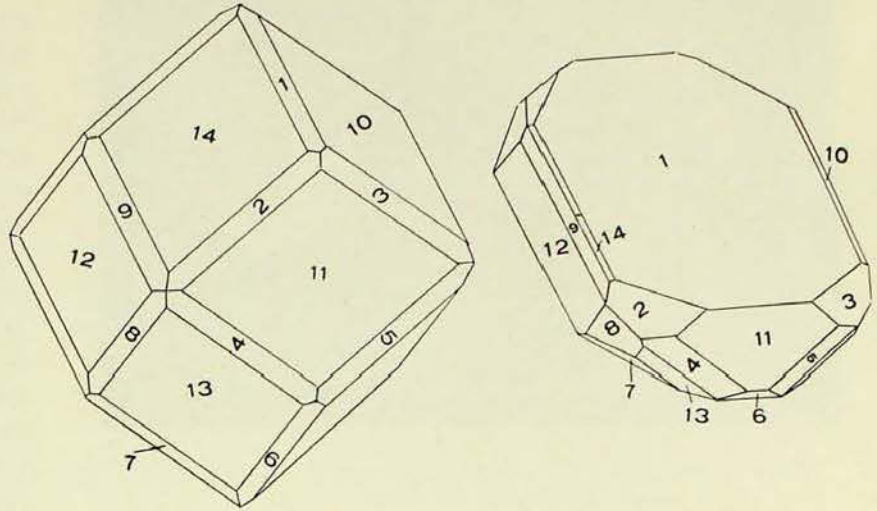
Just as giants are rare among the living creatures so they are in crystals, but they do exist. One crystal of beryl from Albany, Maine, U.S.A., measured eighteen feet in length and four feet in diameter, and weighed eighteen tons. But this is a mere baby beside a single crystal of spodumene from the Etta Tin Mine, South Dakota, U.S.A., which measured forty-seven feet in length and five feet in diameter, and weighed ninety tons.

THE EFFECT OF ENVIRONMENT.

Perhaps the most striking effect of environment is to be seen in the variety of colour that the crystals of a particular species may exhibit. The best-known example is fluorite (calcium fluoride), which commonly forms cubic crystals which may be colourless, white, yellow green, rose-red, crimson-red, violet-blue, sky-blue, or brown. The colour is due to the presence of very slight impurities which existed in the solutions from which the crystals formed. In other words the crystals are not protected by a Pure Foods Act, so that the food or material supplied for their growth is not always pure, in fact, seldom is.

The way in which environment affects the ultimate shape or habit of a crystal is not fully understood, but it is well known that its influence is most important. The garnets of central Australia provide a splendid example. There are probably millions of garnets contained in the crystalline rocks of the Hart Range.

Garnet crystals, Hart Range, Central Australia. These two crystals, which appear to be so different in shape, are bounded by the same faces. Corresponding faces on each crystal are indicated by the same number. The flat crystal occurs as an inclusion in the mica of the pegmatite dykes, while the other and more common type comes from the crystalline rocks.



The shape of these crystals is shown in the illustration. They have formed under conditions of great pressure, but pressure that is applied equally in all directions. In the pegmatite dykes of this region large crystals of mica occur, and sometimes these crystals contain small crystals of garnet. Both these types of garnet crystals possess exactly the same faces, but the one from the mica is flattened in one direction, which is always parallel to the perfect cleavage of the mica. Although they look so different, the angles between corresponding faces, such as d_1 and d_2 , are always the same.

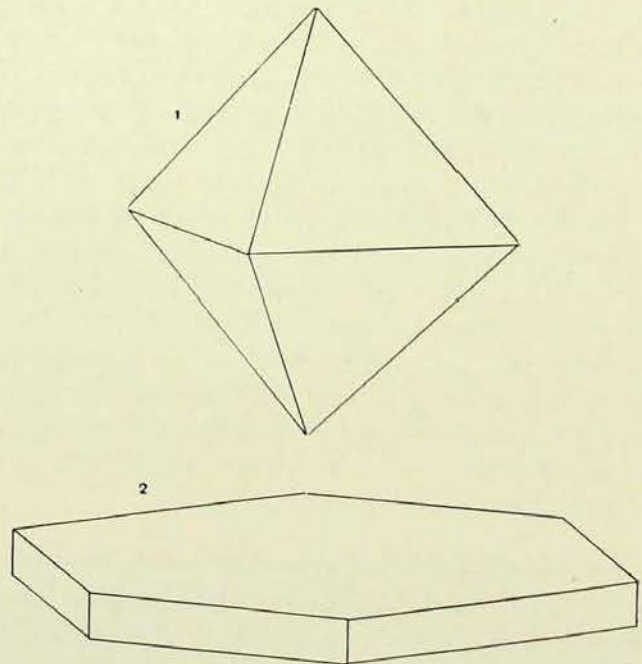
Another effect of environment is to be seen in the crystallization of the element carbon. In Nature carbon is found as two distinct mineral species, the diamond and graphite. The diamond when pure is colourless, transparent, and much harder than any other mineral, while graphite is black, opaque, and very soft. The usual form of diamond is the octahedron and that of graphite an hexagonal plate. These two crystals are fundamentally different, belonging to two different crystal systems. The diamond crystallizes from carbon under conditions of much greater pressure than that necessary for the formation of graphite.

ABNORMALITIES AND TWINS.

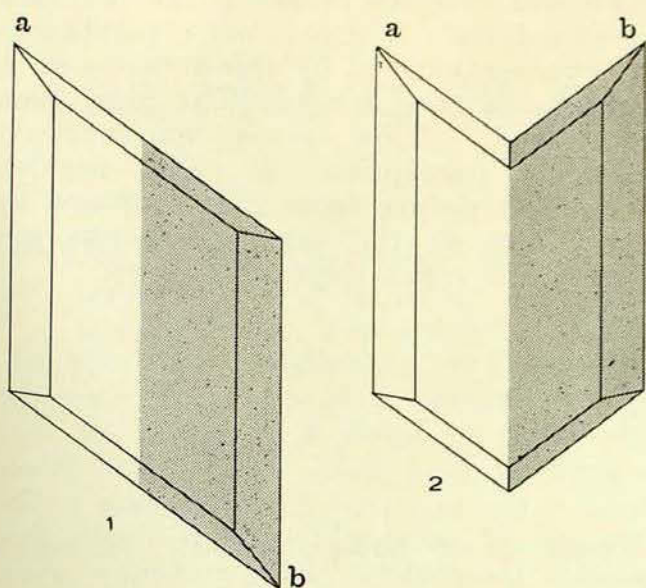
The effect of environment is further seen in the development of abnormal crystals. The faces of a crystal of diamond are often rounded, in some cases

so much so that the crystal appears to be almost spherical. Crystals which grow in groups together in a confined space may mutually interfere with each other so that they possess surfaces which are not true crystallographic faces. Sometimes crystals are bent as in the case of stibnite from Hillgrove, New South Wales.

Sometimes we find crystals which do not appear to conform with the symmetry of the species. These are not simple



1. An octohedron, the more common type of diamond crystal. 2. An hexagonal plate, which is the crystal form assumed by graphite. Both these minerals are composed of the same element, carbon.



crystals, but consist of two or more individuals which are in the reverse position in relation to their immediate neighbours. The accompanying illustration shows a simple crystal and a twin crystal of gypsum. It will be noticed that the shaded portion has been rotated through an angle of 180° ; that is, it is in the reverse position in respect to the other half. This may be repeated any number of times.

THE STRUCTURE OF CRYSTALS.

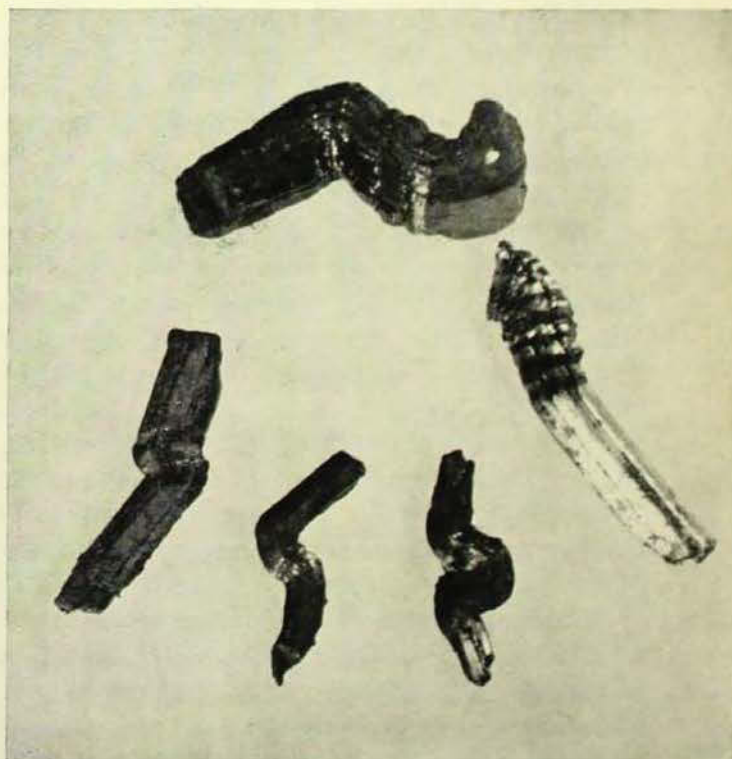
We might well pause to seek the reason why so many minerals form crystals the faces of which are so smooth and highly polished that the most expert lapidary could not possibly attain such a degree of perfection. For a long time the external form of crystals was the only regular thing about them that was recognized. The mineralogist began to seek the reason of this in a regular internal structure.

One day a very clever mathematician named René Just Haüy was being shown some crystals of calcite when, to the horror of the curator, he dropped one. He noticed that the crystal, instead of breaking into irregular fragments, broke up into perfect little rhombohedra, and that these could be still further broken into still smaller rhombohedra. Haüy pondered over this and became convinced

1. A simple crystal of gypsum. 2. A twinned crystal of gypsum. It will be noted that the shaded portion has been rotated through an angle of 180° , so that the point b in the simple crystal is now opposite the point a.

that the regular external form was merely an outward expression of the internal regular arrangement. He considered the smallest particle of a crystal to be a plane-sided solid, by the aggregation of which the crystal was formed. Thus in 1781 he discovered the geometric law of crystallization. True it was only a theory, but the hundreds of thousands of crystals that have been measured since that time have all conformed with Haüy's law.

However, certain difficulties arose because Haüy represented his "molecules" as solids. This was overcome by the work of Bravais, Sohncke, and others which resulted in the development of a point system. The molecules were represented



Stibnite (antimony sulphide), Hillgrove, New South Wales. Note how these crystals are bent and pucker.

by points in space so arranged that every point is surrounded by the same number and same arrangement of other points.

In recent years the work of Laue, Bragg (father and son), and others on the passage of the X-rays through crystals has developed a technique whereby the atoms may be photographed. It is now possible to observe their arrange-

ment and even to measure the distance between them. A great many substances have been examined by this means and a regular atomic arrangement has been established. This gives an entirely different conception of the regular internal structure from that proposed by Hauy, but, at the same time, has not altered his crystallographic laws.

TITANS OF THE BARRIER REEF. Further Adventures of a Shark Fisherman. By Norman W. Caldwell. (Angus & Robertson, Ltd., Sydney, 1938.) Svo, 248 pages, illustrated. Price: 8s. 6d.

Two years ago, Mr. Caldwell's *Fangs of the Sea* was reviewed in this magazine and meanwhile his articles in the *Referee* newspaper have had a wide circle of readers. Now *Titans of the Barrier Reef* carries on in the same strain about his fishing and hunting adventures. The islands and coastline of the beautiful Whitsunday Passage, Queensland, form the background of his activities, of which Caldwell writes in a simple breezy style so that, as in his earlier book, there is a refreshing tang of the salt sea, in the atmosphere of which some of his retailed yarns may be enjoyed *cum grano salis*. His book would make a capital gift for anglers, who will enjoy the captures of big sharks, groper, eels, and crocodiles. To the naturalist the field notes on sharks' habits, food, etc., are most interesting. Those of us who know the Barrier waters will revive happy memories from reading Caldwell's chapters, for Queensland is not as thickly populated with sharks, snakes, crocodiles, or even sandflies as a casual reader might think. There is much variety in the anecdotes: wounds caused by stingray spines, the idiosyncrasies of goats, a shark which spits, and leaping devil rays are some of the subjects, and there is a graphic

account of a hooked whaler eating a turtle.

A few misprints and a line (not of the fishing variety) gone astray on page 47 will doubtless be corrected in later editions, also the mis-spelling of Lindeman Island on the map inside the covers. A pedant might object to an eel being termed, however figuratively, a "reptile" which "gained its second wind" (page 38), whilst Mr. Caldwell's tabulation of the "farming" possibilities of the sea appears too optimistic, since over-fishing, even of Australian sharks, has shown that our marine resources are not "unlimited and most prolific and never problematical".

The book is well supplied with photographs of big sharks and fishes, of which the most unusual is that of a cannibalistic Tiger Shark coming to the surface for the head of another shark, whose tail end it had already devoured.

Mr. Caldwell is a professional shark fisherman who kills only for commerce, or sometimes for science, too, but the wilful waste by other people who merely murder devil rays and other creatures and leave their bodies to pollute the sea and shore is to be condemned. It is only within the last few years that anglers have been tackling the large game species of our waters; whence, as the sibyls sang,

From that hour
The gods wrought evil to the Titan race;
They never prospered.

G.P.W.

The Habits of the Two-spined Spider

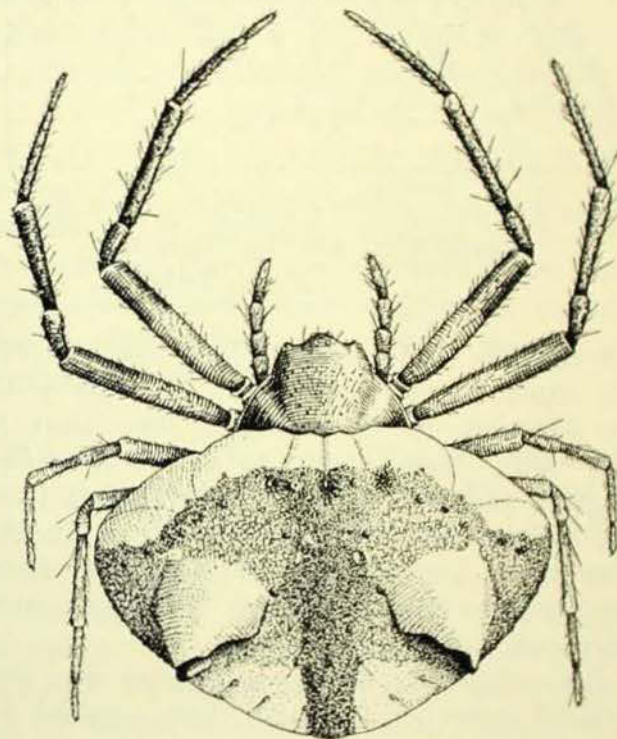
By V. C. LEVITT

FEW of the Australian spiders are more beautiful in colour and form than the Two-spined Spider (*Poecilopachys bispinosa*). It is a dainty little creature, about a quarter of an inch in length, its body marked with brown and yellow in a bold pattern, a colour scheme set off by its bright reddish legs. It is readily identified by the two large creamy-yellow abdominal spines, like small rose thorns. It is one of the few spiders that have been observed to change colour; in life the colour has been seen to flow in waves along the fore-border of the abdomen, and to flush the spines. The spider is not uncommon in the vicinity of Sydney, and has also been recorded from Queensland.

The specimen which formed the subject of these notes was found on a lemon tree, and came into my possession on 14 January, 1937, after it had been kept for several days in a matchbox without food of any sort. It was placed in a large glass jar for convenience of observation, and twigs of honeysuckle, still wet with dew, were placed with it to form a retreat for the spider.

Two days later I decided to attempt to get the spider to feed. Since it had been enclosed in the jar it had remained crouched upon the cover, with its legs drawn up, and even when touched it seemed reluctant to move, stretching out its legs and immediately withdrawing them when left alone. Afraid that it might die of thirst, I put a drop of water in front of it, but, as it seemed to take no notice, I put a drop on it and another beside it. The effect was magical, the spider stirring at once, and, turning aside, it appeared to notice the drop of water beside it. It put its head in the moisture and seemed to suck it up. It then started to explore its surroundings.

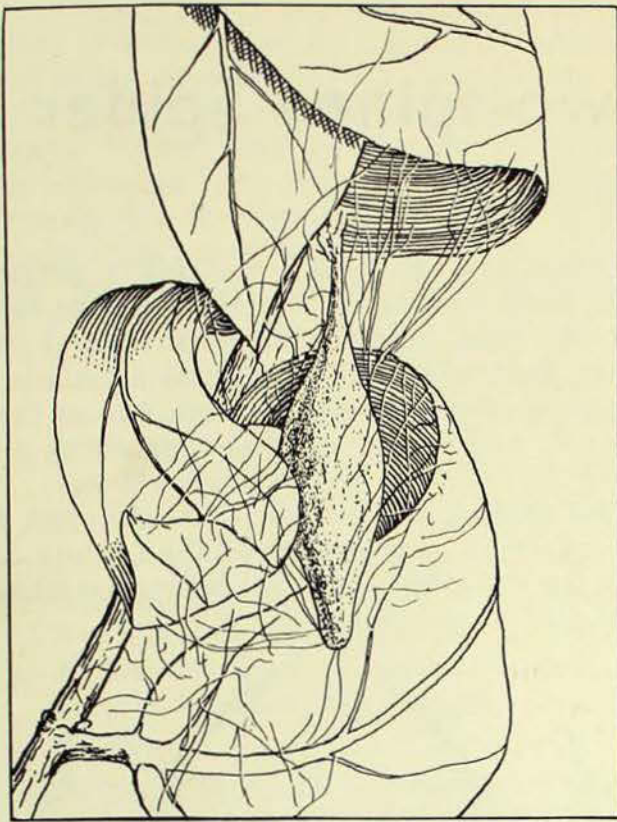
Next day the spider was fairly active and busy, and spun the leaves at the top of the twig together to form a kind of nest, meanwhile taking several horizontal strands of silk across between two of the leaves, which were at that time about an inch to one and a half inches apart. I tried feeding her on flies, but, although I found their dead bodies at the bottom of the jar, I could find no indication that she had eaten them.



The Two-spined Spider (Poecilopachys bispinosa).

N. B. Adams, *del.*

On 18 January, about 5.45 p.m., it was discovered that the spider had made an egg-sac of bright yellow silk, something after the shape of those of the Magnificent Spider (*Dicrostichus magnificus*), but much smaller, and it was anchored at top and bottom with horizontal strands of silk. It was only about half an inch long by about one-eighth inch wide in



*The egg-sac of the Two-spined Spider
suspended among leaves.*

N. B. Adams, *del.*

the middle. When the jar was moved, she came forward and felt the sac with her forelegs, as if to make sure that it was safe, and then returned to her original position. It was unfortunate that the spider was not seen while actually at work on her egg-sac. When I examined the spider that morning she had not begun to spin.

After the first night the spider was not noticed near the egg-sac, but seemed to remain upon any fresh twigs that were placed in the jar from time to time. When a piece of passion-fruit vine was introduced, she spun several sticky horizontal threads between the top of that plant and the uppermost leaves of the honeysuckle, and on several occasions, especially at night, was seen hanging upside-down upon these threads.

I stopped feeding her on flies and changed to pollard moths, and on the night of 1 February I found her upright in this web busily sucking the juices from one of these moths. I have since witnessed

most of the spider's procedure in catching moths. The moth was resting quietly on the cover of the jar, while the spider was running about excitedly. Once she was seen to stroke her victim with her forelegs. The moth, possibly not realizing its danger, did not move. The spider seemed to resent the glare of the electric light in the room and retired to the side of the jar, where she remained, apparently waiting for a further opportunity. At this stage the observations were interrupted by the failure of the electric light, and when conditions had been restored to normal the spider had captured the moth. She had it in her web and was apparently wrapping it up with silk, as she had it in her legs and was turning it round and round, occasionally touching its body with her spinnerets. When she had bound it up to her satisfaction, she turned it round and commenced sucking at its head. Next morning the dry body of the moth was lying at the bottom of the jar.

From time to time the spider climbed upon the cover of the jar, which she had covered with a mat of sticky white silk, and here she remained upside-down with her legs drawn in.

On the night of 3 February I examined the egg-sac to see if there was any change in its appearance. It looked quite as distended as ever, but in the silken side there was a small round hole, such as one might make with a pin. Early on the following morning I found that the spiderlings had hatched out, and were crowded in the network of web surrounding the sac. In all, eighteen days elapsed between the spinning of the egg-sac and the emergence of the spiderlings.

With the appearance of the young spiders, the mother had climbed as high as she could, and seemed to be taking no interest in her family; indeed, upon being shaken down among the leaves she climbed back in frantic haste to her former position, and seemed to be trying to escape from her prison. I then removed her to another jar, and, though at first she remained on the cover, she eventually descended to the top of the twigs, where,

on 6 February, she spun a web consisting of very viscid, rather cloudy, white, horizontal strands of silk placed fairly close together. Unfortunately, part of this web was fixed to the cover of the jar, so that it was necessary to break it in order to introduce food and water to the captive.

For the first two or three days the spiderlings did not move at all, but then they became very active, and spread all over the jar. They are tiny brownish-white spiders, paler on the top of the abdomen, and with a pronounced dark

streak underneath. Even with the aid of a lens nothing could be observed either in colour or form to identify them with their parent in any way.

By 13 February the spiderlings had grown to almost twice their size when first hatched, but had not otherwise changed in appearance. They were never seen to eat, but when water was dropped among them they became extremely active. In the course of their wanderings the tiny spiders covered the whole of the inside of the jar with an almost invisible network of fine threads.

Miss Ethel A. King, who died recently, was an extremely versatile artist, and was well known in scientific and artistic circles. She was regarded as a most faithful delineator. Her talents were used by the late Mr. J. H. Maiden in illustrating his botanical researches, and by the late Mr. W. W. Froggatt also. Other scientific workers, here and abroad, recognized her skill, and much of her work is exhibited in the galleries of the Australian Museum. At the time of her death she had just received an appointment to the Australian Institute of Anatomy, Canberra, for which she had executed a number of commissions previously. She also assisted in the scientific illustration of "The Australian Encyclopaedia".

Mr. W. Boardman, B.Sc., who had been on the scientific staff of the Australian Museum for the past sixteen years, recently resigned his post here to take appointment as Zoologist of the Australian Institute of Anatomy, Canberra, A.C.T.

Mr. Boardman entered our service as cadet and advanced to the position of Assistant Zoologist. Whilst here he was an extremely active officer, ever anxious to advance the department to which he was attached, as well as the Museum generally. Though we regret losing the services of a museum trained man, we, nevertheless, are very pleased that the experience gained here will be of assistance to the institution to which he is now attached.

The death of Mr. F. A. Coghlan removed from the community one who had had a long career in the service of the State, which he had served for a lifetime. Advancing to the position of Under-Secretary of the Chief Secretary's Department, he was appointed Auditor-General, and by virtue of this office he became an Official Trustee of this Museum, which he served zealously from 1916 till his retirement in 1928.

The First Two-Headed Shark in Australia

A YEAR or two ago, in THE AUSTRALIAN MUSEUM MAGAZINE (Vol. vi, Part 5, Jan.-March, 1937, p. 154), I gave an account of "Double-headed Fishes in Australia and New Zealand", including every case then known. I have since learned that, just 100 years ago, a double-headed shark was found in Tasmania, for, in a supplement to the *Australian*, a Sydney newspaper, for 27 March, 1838, we read:

Sharkemese Twins.—A gentleman at Richmond has in his possession a young shark, with two distinct heads and bodies. The bodies join at the dorsal fin, so as to form one tail. The

length is about three inches, and the size of each body is in proportion. This singular formed fish was taken alive, with several single-headed sharks, from the inside of the mother when killed.—*Hobart Town Courier*.

The Tasmanian newspaper from which the above was extracted was the *Hobart Town Courier* for Friday, 9 March, 1838.

Coming to more recent times, we read in the *Sun* newspaper, Sydney, for 26 March, 1928, of a "Grey Nurse" Shark from Sans Souci, Botany Bay, with two heads, two mouths, and four eyes. It was said to have been eleven inches long.

G. P. WHITLEY.

Snakes That Fish

By GILBERT P. WHITLEY

IN the *Sun* newspaper, Sydney, 4 April, 1938, there appeared a curious paragraph entitled "Snake Goes Fishing". It reads as follows:

Bathurst, Monday.

The extraordinary sight of a black snake [*Pseudechis porphyriacus*] emerging from a shallow pool with a small carp fish [*Carassius*] in its mouth, was witnessed by George Gunther and his wife, of Bathurst, at "The Forge", a well-known fishing resort near here.

Gunther fired at the snake, but missed. The reptile dropped the fish and returned to the pool, apparently reluctant to lose its meal.

With his next shot, Gunther killed the snake, which measured five feet.

Whilst sea-snakes are well-known as fish-eaters, and certain northern Australian freshwater snakes (*Myron*, *Acrochordus*, and *Cerberus*) are very partial to fish, the above account is the

only one known to me of a land snake actually caught fishing in Australia.

Mr. J. R. Kinghorn, in his *Snakes of Australia*, 1929, p. 162, says of the Black Snake that: "Those living near rivers almost invariably have frogs, fish, and small eels in their stomachs." There are many American records of snakes as "fishermen", most of the observations dating from the 1880's, and quoted in Bashford Dean's *Bibliography of Fishes*. Mme. Phisalix (*Bull. Stat. Oceanog. Salammbô*, Tunis, xxv, 1931) found that certain eels and other fishes are to some extent immune to snake venom. Many of us have probably seen snakes in our country rivers or marshes, but it seems we must award the prize for serpentine angling to the common Black Snake.